Original article

Effects of direct stenting on epicardial and myocardial perfusion in patients with acute ST segment elevation myocardial infarction

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Abstract

Background: Results of studies comparing direct stenting (DS) with conventional stenting (CS) after balloon predilatation in patients with acute myocardial infarction (MI) have been reported in the past, however they are conflicting. There are only few randomised studies that aim to answer whether DS improves epicardial and myocardial patency.

Aim: To assess the effects of DS on epicardial and myocardial patency in patients with acute MI.

Methods: Consecutive patients with acute MI were randomised either to DS or CS strategy. Clinical exclusion criteria were as follows: clinical and electrocardiographic features of reperfusion, pulmonary oedema, cardiogenic shock, contradictions to coronarography, allergy to aspirin, ticlopidine, clopidogrel, heparin and stainless steel. Angiographic exclusion criteria were as follows: lesion <50% with correct patency in the infarct-related artery (IRA), lesion in the left main coronary artery, previously performed percutaneous coronary intervention in the target vessel, diameter of the IRA <2 mm or >4 mm. We assessed epicardial patency according to the TIMI (thrombolysis in myocardial infarction) scale and myocardial patency according to the TMPG (TIMI myocardial perfusion grade) scale. In addition, we analysed ST segment resolution in 12-lead electrocardiography (ECG). The ECG was performed before and 30 minutes after PCI.

Results: We analysed 300 consecutive patients with acute ST segment elevation MI. After exclusion of patients not suitable for the study design, the DS group comprised 110 patients and the CS group – 107 patients. Clinical and angiographic results were similar in both groups. Initial TIMI 0 (48.2% vs. 43.0%), initial TIMI 3 (31.8% vs. 28.0%), initial TMPG 0-1 (77.3% vs. 78.5%), final TIMI 3 (95.5% vs. 93.5%) and final TMPG 2-3 (68.2% vs. 60.8%) were similar in the DS and CS groups, respectively (p=NS). The incidence of no-reflow phenomenon was comparable in both groups (4.5% vs. 6.5%, NS). The inclusive rate of no-reflow phenomenon plus worsening patency in the IRA were 6.4% vs. 10.3% in the DS and CS groups respectively. The ST segment resolution ≥50% was 58.1% in the DS group and 56.1% in the CS group (NS).

Conclusions: Direct stenting does not significantly improve epicardial and myocardial patency in an unselected group of patients with acute ST segment elevation MI.

Key words: myocardial infarction, direct stenting, epicardial patency, myocardial patency, no-reflow phenomenon

Kardiol Pol 2007: 65: 503-512

Introduction

Treatment of acute myocardial infarction (MI) involves two methods of reperfusion: percutaneous coronary intervention (PCI) and fibrinolytic therapy. Management should be determined by the pain-to-treatment time and PCI availability [1]. The use of PCI for treatment of acute MI significantly improved prognosis of patients. It is associated with a higher rate of final TIMI 3 flow in the target artery compared with fibrinolytic treatment [2]. The next step in the management of acute MI was introduction

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Received: 24 November 2006. **Accepted:** 14 February 2007.

of coronary stents. Routine stent insertion is currently recommended for all patients undergoing primary PCI [1]. For a couple of years the results of clinical trials comparing conventional stenting (CS) with direct stenting (DS) approach in acute MI have been reported.

Balloon predilation often results in arterial wall dissection, leading to rapid, incremental re-thrombosis. Deployment of stent over the excessive iatrogenic dissection may cause frequent reocclusions. Balloon predilation prior to stenting may also lead to mobilisation and displacement of thrombotic mass and distal embolisation. Reperfusion arrhythmias and hypotension requiring medical attention may occur after balloon predilation, particularly during the right coronary artery angioplasty. It is associated with prolonged time to stent deployment.

Reduction of these processes by direct stenting approach could effectively improve epicardial and myocardial perfusion. However, there are few randomised studies available evaluating the utility of direct stenting in the improvement of epicardial and myocardial perfusion. Moreover, there are confounding reports on the role of DS in achieving normal coronary blood flow [3-9]. This study was aimed at comparing the effects of DS versus CS strategy on epicardial and myocardial perfusion in patients with acute MI.

Methods

Study group

This study is based on a sub-analysis of the DIRAMI (DIRect stenting in Acute Myocardial Infarction) trial. The study enrolled consecutive patients with ST-elevation acute MI. The study group comprised patients: 1) >18 years old, 2) with typical chest pain of at least 20-minute duration, not relieved by nitroglycerin, with ST segment elevation of at least 0.1 mV in two or more consecutive ECG leads or new left bundle branch block, 3) with pain-to-hospital time up to 12 hours or between 12 and 24 hours in the case of ECG-documented ischaemia, and 4) after obtaining their written consent to participate in the study.

The following patients were excluded: 1) those with clinical and ECG signs of reperfusion on admission, 2) with pulmonary oedema or cardiogenic shock, 3) with contraindications to cardiac catheterisation, 4) with allergy to aspirin, ticlopidine, clopidogrel, heparin or stainless steel, and 5) not scheduled for urgent coronary angiography.

Study protocol

Patients were randomly assigned to two groups. The first group included patients treated with DS (DS group); the other group comprised patients treated with CS (CS group). All enrolled patients were given aspirin 300-500 mg, intravenous unfractionated heparin 5,000-10,000 IU, and morphine 2.5-5 mg (if not received previously). Additionally, nitroglycerin, beta-blockers, antiarrhythmics, angiotensin-converting enzyme inhibitors and atropine were administered, if indicated.

Subsequently, patients were transferred to the cath lab for coronary angiography. After coronary angiography additional exclusion criteria were applied: 1) <50% stenosis with normal coronary flow, 2) target lesion in the left main coronary artery, 3) previous angioplasty in the same segment as the target lesion, 4) reference artery diameter of <2 mm or >4 mm, and 5) operator's decision not to stent the artery. Patients were also excluded when an attempt to pass the guidewire through the occlusive lesion failed. Patients received clopidogrel 300 mg orally following coronary angiography.

PCI was performed according to the randomisation outcome. The diameter of stent inserted during DS was determined as 1.2 times the reference diameter of the target artery immediately proximally to the lesion. If definite evaluation of lesion length was possible, stents were used on the basis of operator's judgment. However, when determination of lesion length was impossible, stents of >15 mm length were preferred. After insertion of a stent into the vessel, intra-arterial contrast injection was performed to localise both the stent and guidewire. Inflation pressure of ≥12 atmospheres over 30 seconds was recommended. Balloon predilation was performed in case of doubts regarding guidewire and stent locations. Balloon catheter diameter was equal to the arterial reference diameter. Additional heparin injections during the procedure were given depending on its course and duration, and were administered at the operator's discretion. Abciximab was not used routinely, but only in case of persistent large clots and angioplasty complications compromising blood flow.

Evaluation of epicardial and myocardial perfusion

TIMI score was applied for evaluation of epicardial blood flow [10], whereas myocardial perfusion was determined using TIMI myocardial perfusion grade (TMPG) [11]. Intracoronary nitroglycerin 200 μgrams was usually administered prior to evaluation of epicardial and myocardial perfusion. Epicardial and myocardial perfusion was determined by two independent interventional cardiologists. Angiographic evaluation of blood flow through the epicardial coronary artery was performed before the procedure, after placement of the guidewire, and after PCI. Microcirculation was assessed both before and after PCI. No-reflow phenomenon was defined

as persistent TIMI 2 flow or less after PCI, without presence of factors reducing blood flow (large clot, wall dissection, spasm or presence of significant stenosis). Worsening of blood flow was defined as slowing of flow rate in the target artery at any stage of the procedure from passing the guidewire through the lesions.

ECG analysis

Analysis of reperfusion extent also involved 12-lead ECG assessment. Electrocardiograms were recorded before and 30 minutes after PCI. The ST segment resolution (STR) was calculated using the following formula: (sum of ST elevation prior to PCI – sum of ST elevation after PCI)/sum of ST elevation prior to PCI × 100%.

Statistical analysis

Continuous variables of normal distribution are presented as mean ± standard deviation. Statistical significance of differences between the means was assessed using Student's t-test. For non-normal distribution of variables U Mann-Whitney test was used. Discrete parameters were compared using χ^2 test (if expected frequency below 5 the Yates' correction was applied). Results were found statistically significant for $p < 0.05$ (two-sided). Statistical analyses and calculations were performed with Statistica PL software ver. 5.0 (StatSoft Inc.).

Results

The study group was selected from 300 consecutive patients with ST-elevation acute MI. On admission, 52 patients did not meet inclusion criteria; therefore randomisation involved 248 subjects. The DS group included 125 patients, the CS group 123 patients. After coronary angiography 15 and 16 patients were additionally excluded from DS and CS groups, respectively, on the basis of the previously detailed criteria. Finally, the DS group comprised 110 patients and the CS group – 107 patients.

Direct stenting was performed in 97 patients from the DS group and 13 patients (11.8%) required balloon predilation prior to deployment of stent. In 7 cases difficulties occurred while passing the stent through the lesion, and in 4 subjects with TIMI 0-1 flow the guidewire position was uncertain. In a further 2 patients balloon predilation was performed at the operator's discretion and the cause remains unknown. Despite balloon predilation, passing the stent through the lesion failed in one patient.

In one CS patient the stent was not inserted due to excessive tortuosity of the vessel, preventing advancement of the stent into the lesion.

Clinical and angiographic characteristics of both groups are shown in Tables I and II. There were no differences between the groups with respect to age, gender, coronary artery disease risk factors, history of past revascularisations, incidence of fibrinolytic treatment prior to PCI, electrocardiographic localisation of MI, and maximum creatine kinase levels. Coronary angiography revealed no statistically significant differences regarding angiographic localisation of MI, percentage of multi-vessel coronary artery disease, or baseline blood flow through the epicardial artery. Similarly, analysed groups did not differ with respect to baseline microvascular blood flow. Myocardial perfusion was assessed in 104 (94.5%) DS patients and in 98 (91.6%) subjects from the CS group. Stent diameter, stent diameter to arterial reference diameter ratio and length of the first deployed stent were comparable between the groups.

Evaluation of blood flow during the procedure and PCI outcome are detailed in Table III. Epicardial perfusion after passing the guidewire was comparable between the groups. Final TIMI 3 flow was insignificantly more frequent in the DS group. Postprocedural myocardial perfusion was determined in 92 (83.7%) patients in the DS group and 85 (79.4%) patients in the CS group. The TMPG 2-3 flow was observed insignificantly more often in the DS group. Moreover, no-reflow rate was insignificantly lower in the DS group. A similar pattern was found when combined analysis of both deterioration of flow and no-reflow (6.4% vs. 10.3%) was carried out.

Table IV summarises the results of ECG evaluation of reperfusion. Electrocardiogram was evaluated in 105 (95.5%) DS patients and 98 (91.6%) patients in the CS group. There was a trend ($p=0.066$) towards lower rate of STR ≥70% in the DS group compared with the CS group. It is important that in the sub-group of patients with final TIMI 3 flow no significant difference was observed regarding the rate of STR ≥50% in both groups.

Table V shows comparison of DS and CS approach separately for patients treated with primary and rescue PCI. The analysis revealed no signficant differences between the DS and CS groups.

Discussion

Studies comparing DS with CS showed that DS is safe and may be used for treatment of acute coronary syndromes. It was documented that DS had a positive impact on procedure duration, radiation exposure time, amount of contrast agent used and angioplasty costs [5, 7-9, 12]. Observational studies showed that DS compared to CS may also significantly improve prognosis of patients with acute MI. Lower levels of biomarkers of necrosis, higher left ventricular ejection

Table I. Clinical characteristics of the studied patients. No significant differences between the DS and CS groups were found with respect to analysed parameters

	DS group (n=110)	CS group (n=107)
Age [years]	55.6±10.4	57.9±11.3
Age ≥65 years [%]	21.8	29.0
Males [%]	76.4	81.3
Hypertension [%]	48.2	45.8
Diabetes mellitus [%]	16.4	17.8
Hypercholesterolaemia [%]	57.3	47.7
Smoking [%]	70.9	63.6
Family history of coronary artery disease [%]	32.7	42.1
Past myocardial infarction [%]	14.5	16.8
Past PCI [%]	3.6	6.5
Past CABG [%]	0.0	0.9
Anterior wall myocardial infarction [%]	45.5	39.3
Heart rate on admission	81.8±18.5	79.4±18.9
Fibrinolysis prior to PCI [%]	41.8	35.5
Streptokinase [%]	40.9	32.7
Others [%]	0.9	2.8
Max creatine kinase level [U/l]	2764±2274	2708±2222

Abbreviations: PCI – percutaneous coronary intervention, CABG – coronary artery bypass grafting

Table II. Angiographic characteristics of the studied patients. No significant differences between the DS and CS groups were found with respect to analysed parameters

	DS group (n=110)	CS group (n=107)
Target artery [%]		
LAD	46.0	42.0
Cx	11.0	10.0
RCA	43.0	48.0
Multi-vessel coronary artery disease [%]	45.5	43.9
Abciximab administration [%]	4.5	2.8
Thrombus visualised in baseline angiography [%]	49.1	44.9
Epicardial flow acc. to TIMI in baseline angiography [%]		
Grade 0	48.2	43.0
Grade 1	9.1	11.2
Grade 2	10.9	17.8
Grade 3	31.8	28.0
Microvascular flow acc. to TMPG in baseline angiography [%]		
Evaluation not possible	5.5	8.4
Grade 0–1	77.3	78.5
Grade 2–3	17.2	13.1
Stent diameter [mm]	3.1±0.4	3.2±0.4
Stent diameter to reference artery diameter ratio	1.1±0.2	1.1±0.1
First stent length [mm]	16.7±4.9	17.0±5.0

Abbreviations: LAD – left anterior descending branch of the left coronary artery, Cx – circumflex branch of the left coronary artery, RCA – right coronary artery, TIMI – thrombolysis in myocardial infarction, TMPG – TIMI myocardial perfusion grade

Table III. Blood flow through the target artery and microcirculation during and after the procedure. No significant differences between the DS and CS groups were found with respect to analysed parameters

	DS group (n=110)	CS group (n=107)
Epicardial flow acc. to TIMI [%]		
After passing guidewire		
Grade 0	15.5	18.7
Grade 1	33.6	23.4
Grade 2	19.1	28.0
Grade 3	31.8	29.9
After the procedure		
Grade 0	0.0	0.9
Grade 1	0.0	0.9
Grade 2	4.6	4.7
Grade 3	95.5	93.5
Microvascular flow acc. to TMPG [%]		
After the procedure		
Evaluation not possible	16.3	20.6
Grade 0–1	15.5	18.7
Grade 2–3	68.2	60.8
Worsening of blood flow during the procedure [%]	1.8*	5.6
after 1st inflation of balloon	0.9	0.9
after next balloon inflations	0.0	1.9
after deployment of stent	0.9	2.8
No-reflow [%]	4.5	6.5
Worsening of flow or no-reflow [%]	6.4	10.3

** Two cases of flow decrease were observed in direct stenting patients requiring balloon predilation*

Abbreviations: TIMI – thrombolysis in myocardial infarction, TMPG – TIMI myocardial perfusion grade

Table IV. Electrocardiographic evaluation of reperfusion. No significant differences between the DS and CS groups were found with respect to analysed parameters

	DS group (n=110)	CS group (n=107)
Mean ST elevation resolution [%]	49.2±32.0	50.7±34.3
ST resolution ≥30% [%]	70.5	68.4
ST resolution ≥50% [%]	58.1	56.1
ST resolution ≥70% [%]	26.7	38.8
ST resolution ≥50% and TIMI 3 [%]	59.0	58.7

Abbreviation: TIMI – thrombolysis in myocardial infarction

fraction, shorter hospitalisation and lower mortality were reported during 30-day follow-up in patients undergoing DS [3, 8]. Ly et al., investigating patients who received fibrinolytic therapy, noticed that DS was associated with lower rate of congestive heart failure. Cumulative analysis of in-hospital and 30-day mortality, MI and congestive heart failure confirmed the superiority of the DS approach [4].

In our study the effects of DS were analysed by examining epicardial and myocardial perfusion. Baseline angiographic parameters were similar in both groups which resulted from the methodology used. It is worth mentioning that there was a high rate of baseline TIMI 0 flow in both DS and CS groups. High percentage of TIMI 0 flow in the DS group persisted after passing the guidewire. This finding did not result in patients' withdrawal from the procedure. It is divergent with the angiographic exclusion criteria assumed by other investigators [3, 6, 9].

Final blood flow through the target artery is an extremely important angiographic parameter that determines prognosis in patients with AMI. Achieving

Table V. Clinical, angiographic and electrocardiographic characteristics of subgroups undergoing primary and rescue PCI

	Primary PCI		Rescue PCI	
	DS group	CS group	DS group	CS group
Clinical characteristics				
Number of patients	64	69	46	38
Age [years, mean]	55.5±10.38	58.3±12.53	55.8±10.4	58.7±9.9
Age ≥65 years [%]	20.3	30.4	23.9	26.3
Males [%]	76.6	84.1	76.1	76.3
Hypertension [%]	43.8	50.7	54.4	36.8
Diabetes mellitus [%]	12.5	18.8	21.7	15.8
Hypercholesterolaemia [%]	57.4	51.6	68.3	51.4
Smoking [%]	75.0	63.8	65.2	63.2
Family history of coronary artery disease [%]	31.3	43.5	34.8	39.5
Past myocardial infarction [%]	10.9	21.7	19.6	7.9
Past PCI [%]	3.1	8.7	4.4	5.3
Anterior wall myocardial infarction [%]	42.2	33.3	47.8	50.0
Max creatine kinase level [U/l]	2456.5±1839.1	2339.9±1742.0	3190.9±2732.7	3283.7±2835.3
Angiographic characteristics				
Target artery [%]				
LAD	45.3	37.7	47.8	50.0
Cx	6.3	10.1	17.4	10.5
RCA	48.4	52.2	34.8	39.5
Multivascular coronary artery disease [%]	45.3	44.9	45.7	42.1
Abciximab administration [%]	6.3	2.9		
Thrombus visualised in the artery	42.2	34.8	58.7	63.2
Epicardial flow acc. to TIMI [%] in baseline angiography				
Grade 0	62.5	56.5	28.3	18.4
Grade 1	12.5	11.6	4.4	10.5
Grade 2	7.8	14.5	15.1	23.7
Grade 3	17.2	17.4	52.2	47.4
Microvascular flow acc. to TMPG in baseline angiography [%]				
Evaluation not possible	1.6	4.3	10.9	15.8
Grade 0-1	87.3	92.4	73.2	71.9
Grade 2-3	12.7	7.6	26.8	28.1
Stent diameter [mm]	3.1±0.33	3.2±0.38	3.1±0.39	3.1±0.39
First stent length [mm]	16.1±4.0	17.0±5.0	17.4±6.0	17.0±5.2
Blood flow through the target artery and microcirculation during and after the procedure				
Epicardial flow acc. to TIMI [%]				
After passing guidewire				
Grade 0	17.2	24.6	13.0	7.9
Grade 1	46.8	24.7	15.2	21.1
Grade 2	14.1	30.4	26.1	23.6
Grade 3	21.9	20.3	45.7	47.4
After the procedure				
Grade 0	0.0	0.0	0.0	2.6
Grade 1	0.0	1.5	0.0	0.0
Grade 2	6.3	5.8	2.2	2.6
Grade 3	93.7	92.7	97.8	94.8

Table V – continued

Microvascular flow acc. to TMPG [%]				
After the procedure				
Evaluation not possible	14.1	15.9	19.6	28.9
Grade 0-1	20.0	20.7	16.2	29.6
Grade 2-3	80.0	79.3	83.8	70.4
Worsening of blood flow during the procedure [%]	1.7	3.5	4.4	5.2
No-reflow [%]	4.6	5.6	2.2	5.2
Worsening of flow or no-reflow [%]	6.3	9.1	6.6	10.5
Electrocardiographic evaluation of reperfusion				
Mean ST elevation resolution [%]	52.9±30.2	54.1±34.9	44.3±34.0	44.4±32.7
ST resolution ≥30% [%]	76.7	73.4	62.2	58.5
ST resolution ≥50% [%]	60.0	60.9	55.6	47.1
ST resolution ≥70% [%]	30.0	43.6	22.2	29.4

Abbreviations: PCI – percutaneous coronary intervention, LAD – left anterior descending branch of the left coronary artery, Cx – circumflex branch of the left coronary artery, RCA – right coronary artery, TIMI – thrombolysis in myocardial infarction, TMPG – TIMI myocardial perfusion grade

final TIMI 3 flow is associated with reduced in-hospital and long-term mortality. TIMI 3 flow was documented to be an independent predictor of lower mortality [13-15]. Observational studies revealed that the DS approach may lead to better effectiveness of coronary angioplasty than the CS approach [3, 4, 6].

However, our results do not confirm that DS may increase the rate of successful PCI with TIMI 3 outcome. This remains consistent with the conclusions of other randomised trials on DS [7, 9].

Despite optimal flow in the epicardial artery, patients' prognosis also depends on restoration of myocardial perfusion. Henriques et al. showed that in patients with TIMI 3 outcome 16-month mortality was 4 times higher in the MBG 0-1 subgroup than the MBG 2-3 group [16]. This correlation may be due to the fact that patients with worse myocardial perfusion have higher levels of biomarkers of myocardial necrosis and lower left ventricular ejection fraction [17, 18]. Microvascular flow was also analysed in DS patients. The multicentre, non-randomised DISCO 3 (DIrect Stenting of COronary arteries) trial showed that TMPG 2-3 rate was significantly higher in the DS group than the CS group (83.5% vs. 68.9%). Additionally, multivariate analysis demonstrated DS to be an independent predictor of grade of myocardial reperfusion [3]. Furthermore, in the study of Ly et al. the DS approach was shown to be an independent predictor of TMPG 3 outcome [4]. Our study did not confirm those findings – TMPG 2-3 rate only tended to be higher in patients undergoing DS.

As mentioned earlier, microvasculature perfusion may become compromised due to distal embolisation. Such a presumption led to the hypothesis that direct stenting may reduce incidence of no-reflow. Our analysis failed to confirm that suggestion. Similarly, Suselbeck et al., investigating patients with acute coronary syndromes, did not show a statistically significant difference with respect to the frequency of no-reflow phenomenon (4.0% in DS group and 9.0% in CS group) [5]. Similar are conclusions from a randomised study conducted by Sabatier et al. [9]. Different results were reported by Antoniucci et al. Incidence of no-reflow was significantly lower in the DS group than in the CS group (5.5% vs. 12.0%). Moreover, the DS approach limited the presence of the no-reflow phenomenon in the subgroup of patients with a mean artery diameter below 15 mm [8]. Absence of no-reflow phenomenon in the DS group was described by Timurkaynak et al. (0% vs. 13.0% in DS and CS groups, respectively). No-reflow was defined as sudden worsening of flow rate (TIMI 0-1) following successful coronary angioplasty [6]. The main limitation of the above-mentioned studies was non-randomised patients' assignment to respective treatment groups. Loubeyre et al. noted a significant difference in favour of DS in combined angiographic endpoint of no-reflow, distal embolisation and flow slowing (11.7% vs. 26.9%). No-reflow was defined as a decrease of blood flow from TIMI 3 or 2 to TIMI 0 or 1; flow slowing was defined as a decrease of flow from TIMI 3 to TIMI 2. Separateanalysis of no-reflow

showed no differences between the groups (4.9% vs. 7.6% for DS and CS groups, respectively) [7].

In addition to coronary angiography, 12-lead ECG may also be used to assess epicardial and myocardial perfusion. Strong correlation was found between ST resolution and epicardial and myocardial blood flow. Brodie et al. showed that in patients with ST-elevation MI treated with primary PCI degree of ST resolution was strongly related to final epicardial blood flow [19]. Sorajja et al. reported that the percentage of coexistence of STR >70% and MBG 2-3 or STR <70% and MBG 0-1 was 60.1% [18].

In our study STR ≥50% was an established reperfusion criterion. No significant superiority of the DS approach was found either in the entire analysed group or in patients with TIMI 3 outcome. Compared to our findings, Antoniucci et al. showed a higher percentage of ST resolution ≥50% with no considerable differences between the DS and CS groups (68.0% vs. 61.0%) [8]. It must be remembered that the study of Antoniucci et al. excluded patients treated with fibrinolysis. Loubeyre et al. obtained opposite results. Absence of STR ≥50% (30-60 minutes after PCI) was significantly lower in the DS patients (20.2% vs. 38.1%) [7]. Similarly, Cuellas et al. reported higher incidence of STR >70% assessed one hour after PCI in patients undergoing direct stenting. Multivariate analysis indicated DS as an independent predictor of STR >70% [3]. However, no differences regarding STR grade in DS and CS groups in this study is a consequence of similar outcome regarding epicardial and pericardial perfusion as well as similar incidence of no-reflow phenomenon.

Limitations of the study

This is a single centre study. The study group comprised patients undergoing both primary and rescue PCI, after failed fibrinolytic therapy. However, according to results of additional subgroup analysis it is unlikely that DS could considerably influence epicardial and myocardial perfusion in subgroups undergoing primary or rescue PCI. Epicardial and myocardial perfusion assessment as well as the study itself were performed at the same site. Additionally, epicardial flow assessment did not include CTFC score (corrected TIMI frame count). There are reports available that post-reperfusion flow may depend on the glycoprotein IIb/IIIa blocker usage [20]. Our study did not perform analysis to determine the role of these agents. It is worth mentioning that the same limitations were named by the cited papers.

Conclusion

Epicardial and myocardial perfusion was not significantly improved by a direct stenting approach in a non-selected population of patients with ST-elevation acute myocardial infarction.

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Wpływ bezpośredniego stentowania na przepływ nasierdziowy i mięśniowy u chorych z zawałem serca z uniesieniem odcinka ST

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Streszczenie

Wstęp: Od kilku lat pojawiają się wyniki badań porównujących konwencjonalną metodę implantacji stentów (ang. *conventional stenting*, CS) z techniką stentowania bez uprzedniej predylatacji balonowej (ang. *direct stenting*, DS) w ostrym zawale serca (MI). Niewiele jest badań z randomizacją, w których oceniano przydatność DS w poprawie przepływu na poziomie nasierdziowym i mięśniowym. Ponadto istnieją rozbieżne doniesienia na temat roli DS w uzyskaniu przepływu.

Cel: Określenie wpływu DS na stopień perfuzji nasierdziowej i mięśniowej u chorych z MI dobranych losowo.

Metodyka: Praca jest oparta na podanalizie badania DIRAMI, do którego włączono kolejnych chorych z ostrym MI z uniesieniem odcinka ST (STEMI). Z analizy wyłączono chorych: 1) z klinicznymi i elektrokardiograficznymi cechami reperfuzji przy przyjęciu, 2) z obrzękiem płuc i wstrząsem kardiogennym, 3) z przeciwwskazaniami do cewnikowania serca, 4) z alergią na kwas acetylosalicylowy, tiklopidynę, klopidogrel, heparynę, stal nierdzewną, 5) wobec których podjęto decyzje o niewykonywaniu koronarografii w trybie natychmiastowym. W wyniku randomizacji chorych zakwalifikowano do dwóch grup. Grupę pierwszą stanowili chorzy, u których zamierzano wykonać DS (grupa DS), grupę drugą chorzy, u których zamierzano wykonać CS (grupa CS). Po wykonaniu koronarografii dodatkowymi kryteriami wykluczenia były: 1) zwężenie <50% z prawidłowym przepływem przez tętnicę, 2) lokalizacja zmiany odpowiedzialnej za zawał w pniu lewej tętnicy wieńcowej, 3) wcześniejsza przezskórna interwencja wieńcowa (PCI) w segmencie tętnicy, w którym zlokalizowana była zmiana zawałowa, 4) średnica referencyjna naczynia zawałowego <2 mm lub >4 mm, 5) decyzja operatora o niestentowaniu tętnicy. Do oceny przepływu na poziomie nasierdziowym zastosowano skalę TIMI (*Thrombolysis in Myocardial Infarction*). Przepływ na poziomie mikrokrążenia oceniano przed i po PCI. Do analizy stopnia reperfuzji użyto również 12-odprowadzeniowego EKG, które wykonywano przed i 30 min po PCI.

Wyniki: Przeanalizowano 300 kolejnych chorych ze STEMI. Po uwzględnieniu kryteriów wykluczenia z badania, grupę DS utworzyło 110 chorych, a grupę CS 107 chorych. Charakterystyka kliniczna i angiograficzna grup była podobna. Wyjściowy przepływ TIMI 0 w grupie DS stwierdzono w 48,2%, w grupie CS w 43,0%, natomiast przepływ TIMI 3 odpowiednio w 31,8 i 28,0%. W powyższych grupach wyjściowy przepływ TMPG 0–1 wynosił odpowiednio 77,3 oraz 78,5%. Końcowy przepływ TIMI 3 był nieistotnie wyższy w grupie DS niż w CS (95,5 *vs* 93,5%). Przepływ mięśniowy po zabiegu został oceniony u 92 chorych (83,7%) w grupie DS oraz u 85 chorych (79,4%) w grupie CS. Przepływ TMPG 2–3 był nieistotnie częstszy w grupie DS (68,2 *vs* 60,8%). Stwierdzono także nieistotnie statystycznie niższy odsetek występowania zjawiska *no-reflow* w grupie DS (4,5 *vs* 6,5%). Podobną zależność stwierdzono, gdy analizie poddano łącznie pogorszenie przepływu i *no-reflow* (6,4 *vs* 10,3%). Nie wykazano różnic w stopniu normalizacji odcinka ST (STR) pomiędzy grupami. Odsetek STR ≥50% wynosił 58,1 i 56,1%, odpowiednio dla grup DS i CS. Również w podgrupie chorych z końcowym przepływem TIMI 3 nie zaobserwowano istotnej różnicy w odsetku STR ≥50% w obydwu grupach (59,0 *vs* 58,7%, odpowiednio dla DS i CS).

Wnioski: Technika DS nie poprawia w sposób istotny przepływu na poziomie nasierdziowym i mięśniowym w niewyselekcjowanej grupie chorych ze STEMI.

Słowa kluczowe: zawał serca, bezpośrednie stentowanie, przepływ nasierdziowy, przepływ mięśniowy, zjawisko *no-reflow*

Kardiol Pol 2007: 65: 503-512

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Praca wpłynęła: 24.11.2006. **Zaakceptowana do druku:** 14.02.2007.