Original Research Article

Acute myocardial infarction due to the unprotected left main coronary artery disease: The power of TIMI 3 flow

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ARTICLE INFO

ABSTRACT

Introduction: Acute myocardial infarction (MI) due to unprotected left main coronary artery (ULMCA) as an infarct-related artery is a rare disease with a poor in-hospital and long-term outcome. A nearly linear correlation between post-percutaneous coronary intervention (PCI) Thrombolysis in Myocardial Infarction (TIMI) 3 grade and improved outcome is well known, however poorly reported in regard to ULMCA.

Aim: To assess the impact of pre- and post-procedural TIMI flow grade on outcomes of emergency PCI in men and women with acute MI due to the ULMCA disease.

Material and methods: Data were selected from the ongoing, nationwide, multicenter, prospective, observational registry. The study group consisted of 643 consecutive patients hospitalized during one year with acute MI with ULMCA as an infarct-related artery. Data analyzed included information from patients' history, coronary risk factor profile, clinical presentation, therapeutic approach and adjunctive treatment. The primary end-points were in-hospital, 30-day, and 12-month mortality.

Results and discussion: There were 184 women and 459 men (28.6% vs. 71.4%), $P < 0.0001$. PCI was performed in 120 women and in 279 men (65.2% vs. 60.8%; $P = 0.3$) with a high rate of post-procedural TIMI 3 flow (87.6% vs. 82.1%; $P = 0.17$). Successful PCI defined as the restoration of TIMI flow grade 3 was the only factor decreasing in-hospital (OR 0.1, 95% CI (0.05–0.23), $P < 0.0001$) and 12-month (OR 0.2, 95% CI (0.13–0.3), $P < 0.0001$) mortality.

Conclusions: In patients with acute MI survival after ULMCA PCI depended on TIMI grade before and after the procedure.

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1. Introduction

Acute myocardial infarction (MI) due to unprotected left main coronary artery (ULMCA) as an infarct-related artery (IRA) is a rare disease with a poor in-hospital and long-term outcome, especially when complicated by cardiogenic shock.[1] The beneficial role of immediate either pharmacological or mechanical reperfusion is unquestionable. The degree of reperfusion has been usually assessed by means of Thrombolysis in Myocardial Infarction (TIMI) grade.[2] A nearly linear correlation between post-percutaneous coronary intervention (PCI) TIMI 3 grade and improved outcome is well known,[3] however poorly reported in regard to ULMCA. Contrary to stable patients with ULMCA disease a decision whether to perform PCI or coronary artery by-pass grafting (CABG) is not evidence-based as guidelines on ULMCA revascularization in the setting of acute MI are not unequivocal.[4,5] Nevertheless, PCI is often the only option for those patients due to hemodynamical and electrical unstability as ULMCA supplies a large amount of myocardium. Although in-hospital mortality remains very high (35%–44%), results from some observational studies encourage to perform PCI in this subset of patients.[6–9] Gender-related differences in the management and outcomes of patients with acute coronary syndromes are well described,[10] however data on population with ULMCA disease are scarce.

2. Aim

The aim of our study was to assess the impact of pre- and post-procedural TIMI flow grade on outcomes of emergency PCI in men and women with acute MI due to ULMCA.

3. Material and methods

The principles of our registry (PL-ACS) have been reported elsewhere and are available on-line.[11,12] Briefly, this is an ongoing, nationwide, multicenter, prospective, observational mandatory registry of all consecutive ACS cases in Poland. So far, there are over 435 000 cases recorded. The study group consisted of 643 consecutive patients hospitalized during one year with acute MI with ULMCA as an IRA. Data analyzed included information from patients' history, coronary risk factor profile, clinical presentation, therapeutic approach and adjunctive treatment. The primary end-points were in-hospital, 30-day, and 12-month mortality. Mortality data were obtained for all the subjects included. The primary results of our LM study from our registry were reported elsewhere.[13]

3.1. Statistical analysis

Variables were expressed as mean ± standard deviation, counts and percentages or median and interquartile ranges as appropriate. The significance between groups was tested using Student's t test, Mann–Whitney U test or Kruskal–Wallis ANOVA test depending on normality as well as homogeneity of variances tested by F test. Categorical variables were tested by χ^2 test. Follow-up mortality was analyzed using the Kaplan–Meier method for multiple-group comparisons. A multivariate Cox proportional hazard regression model was performed to adjust the influence of important clinical factors on mortality. Odds ratios (OR), relative risks (RR) and 95% confidence intervals (CI) were calculated. A two-sided P-value less than or equal to 0.05 was considered significant. For all calculations, Statistica 7.1 software (StatSoft, Inc., Tulsa, OK, USA) was used.

4. Results

There were 184 women (28.6%) and 459 men (71.4%). Women were generally older than men (69.0 ± 12.3 vs. 64.5 ± 11.0 years; P < 0.0001) with a significant proportion of women over 65 (69.6% vs. 51.2%; P < 0.0001), with arterial hypertension (73.9% vs. 64.3%; P = 0.019), diabetes (32.1% vs. 21.8%; P = 0.0063) and obesity defined as BMI more than 30 kg/m^2 (27.2% vs. 10.7%; P < 0.0001). Men more frequently smoked (39.0% vs. 19.0%; P < 0.0001). Less women than men presented earlier than 2 hours from symptom onset (8.2% vs. 13.9%; P = 0.043). Differences in the incidence of dyslipidemia, prior MI and revascularization, cardiogenic shock, infarct size, left ventricular ejection fraction and extent of the disease (single vs. multivessel) were insignificant. Therapeutic strategy was similar in men and women. PCI was performed in 120 women and in 279 men (65.2% vs. 60.8%; P = 0.3) with a high rate of post-procedural TIMI 3 flow (87.6% vs. 82.1%; P = 0.17). Intraaortic balloon counterpulsation (IABP) was implanted in 13.6% of women and in 10.7% of men (P = 0.3). Tables 1 and 2, and Figs. 1–3 show that survival after ULMCA angioplasty depends on TIMI flow before the procedure. Successful PCI defined as the restoration of TIMI flow grade 3 through the left main coronary artery occurred much more frequently in patients with pre-procedure TIMI grade 3 (Table 3). In multivariate regression analysis a successful PCI assessed as the post-procedural TIMI grade 3 flow was the only factor determining better in-hospital (OR 0.1, 95% CI (0.05–0.23), P < 0.0001) and 12-month (OR 0.2, 95% CI (0.13–0.3), P < 0.0001) survival while advanced age, STEMI, prior MI and Killip class 3 or 4 on admission significantly increased mortality.[13]

Table 1 – Mortality according to the pre-procedural TIMI flow.

	Women	Men	P
TIMI flow 0 or 1; 242 (61%)			
In-hospital	22 (31%)	52 (30%)	0.85
30-Day	24 (34%)	58 (34%)	0.93
12-Month	29 (41%)	67 (39%)	0.72
TIMI flow 2; 70 (17%)			
In-hospital	5 (28%)	8 (15%)	0.30
30-Day	5 (28%)	9 (17%)	0.33
12-Month	7 (39%)	13 (25%)	0.26
TIMI flow 3; 88 (22%)			
In-hospital	4 (13%)	5 (9%)	0.71
30-Day	5 (16%)	7 (12%)	0.75
12-Month	8 (26%)	13 (23%)	0.74

Table 2 – Statistical significance of mortality according to the pre-procedural TIMI flow.

	Statistical significance		
	Women	Men	All
TIMI 0 or 1 vs. TIMI 2 flow			
In-hospital	0.76	0.034	0.049
30-Day	0.60	0.024	0.027
12-Month	0.85	0.066	0.091
TIMI 0 or 1 vs. TIMI 3 flow			
In-hospital	0.049	0.0012	0.0002
30-Day	0.063	0.0019	0.0003
12-Month	0.13	0.027	0.008

Fig. 3 – The Kaplan–Meier mortality curves for men with initial TIMI grade 0-1, 2 and 3 flow.

5.   Discussion

The grade of TIMI 3 flow, both pre- and post-procedural, has been described as one of the most important prognostic factors.[3,14] Stone et al. combined data on over 2500 patients from four PAMI trials and demonstrated that pre-procedure TIMI flow grade 3 was associated with preserved left
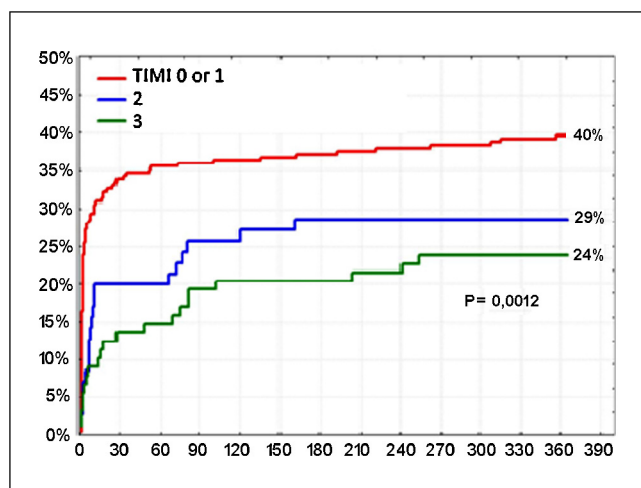

Fig. 1 – The Kaplan–Meier mortality curves for patients with initial TIMI grade 0-1, 2 and 3 flow.
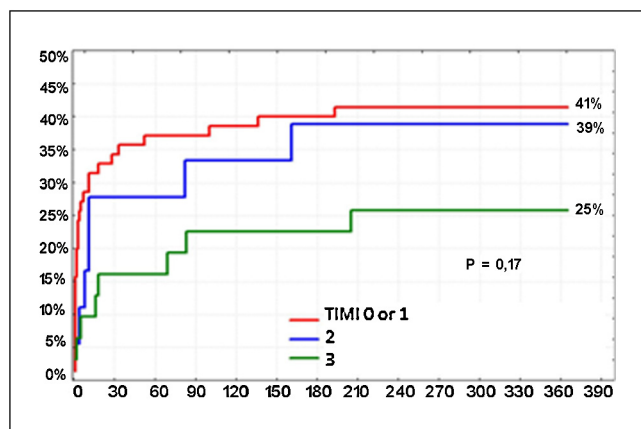

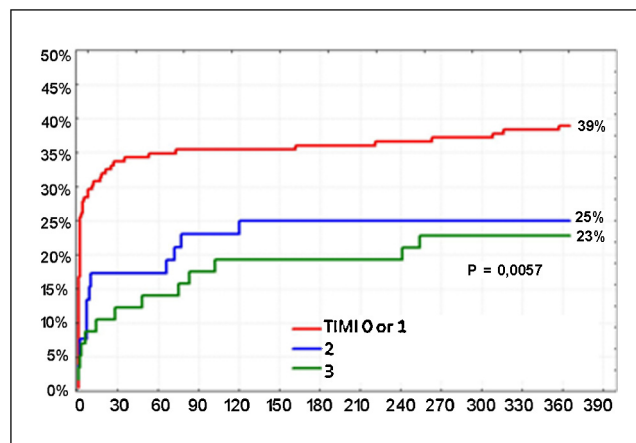Fig. 2 – The Kaplan–Meier mortality curves for women with initial TIMI grade 0-1, 2 and 3 flow.

ventricular function, lower rate of heart failure and lower mortality.[15] The reperfusion efficacy after PCI may be significantly higher with the use of platelet glycoprotein IIb/IIIa inhibitors. Additionally, it increases the likelihood of maintaining TIMI flow grade 3 after PCI even in patients with pre-procedure TIMI flow grade 3.[16]

In many registries, similar to the present study, there were no significant differences regarding pre-procedure TIMI flow grades in the infarct-related coronary artery. In our group almost 43% of patients had totally occluded vessels (TIMI flow grade 0), the remaining TIMI flow grades (1–3) occurred at similar rates. Analysis of detailed data revealed that in-hospital and long-term prognosis depended on the magnitude of pre-procedure blood flow (TIMI grades); the lower the pre-procedure TIMI flow grade the higher the mortality. Although this relationship is significant for the whole group, analysis taking into account gender shows that the significant relationship only existed in men. It is a result of the small sample of women; however a similar qualitative association was clearly visible in the Kaplan–Meier survival curves. Pre-procedure TIMI flow through the left main coronary artery determines also angiographic success of PCI. Both in men and women the highest procedural efficacy was achieved with pre-procedure TIMI flow grade 3. Other than TIMI flow grades 3 produced worse outcomes. Multivariate regression analysis regarding the effect of TIMI flow grades on in-hospital and long-term prognosis demonstrated that TIMI flow grade 3 after PCI is a factor causing about fivefold improvement in survival as compared with patients in whom complete myocardial reperfusion is not achieved at one-year follow-up for the whole group). These data confirm Stone's findings that post-procedure TIMI flow more than grade 3 is associated with worse prognosis.[16] Parma et al. found in a study on 58 patients with acute MI due to ULMCA disease post-procedural TIMI flow less than grade 3 to be an independent negative predictor of short- and long-term mortalities.[17] Similarly, in the present study a successful PCI was associated with better survival. However, cardiogenic shock remains the strongest reason of poor outcomes in this setting of patients. Even if reperfusion is complete and immediate angiographic outcome is excellent,

Table 3 – PCI success rate (post-procedural TIMI grade 3 flow) according to the pre-procedural TIMI grade.										
Initial TIMI grade 0, 1 or 2 312 (78%)				Initial TIMI grade 3 88 (22%)				P value		
Women	Men	All	P	Women	Men	All	P	Women	Men	All
74 (84%)	173 (77%)	247 (79%)	.18	30 (97%)	57 (100%)	87 (99%)	.35	.11	<.0001	<.0001

in the presence of shock the mid- and long-term result is uncertain due to continuous deterioration of patient's condition. Advances in the adjunctive treatment (i.e. thrombectomy, modern antiplatelet and antithrombin agents) increase reperfusion rate, but do not directly improve hemodynamic parameters. IABP was the one to give hope. In our group IABP was implanted in less than 15% of patients. Unfortunately, the results of IABP-SHOCK II Trial were disappointing and made interventionalists to seek for another left ventricular support.[18] Mehta et al. found that in patients with acute MI and cardiogenic shock the post-procedural TIMI grade less than 3 was associated with higher mortality and that ULMCA as IRA was the independent predictor of the post-PCI TIMI grade 0-2.[19] Pappalardo et al. also demonstrated good treatment outcomes; however no significant predictors of mortality were identified.[20] Nevertheless, in our study both initial and post-procedural TIMI grade 3 flow remained the only predictor of better survival.

6. Conclusions

In patients with acute MI survival after ULMCA PCI depended on TIMI grade before and after the procedure.

Conflict of interest

None declared.

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