Quality control project in ST elevation myocardial infarction

STEMI registration in Belgium

Differences in management and outcome between patients admitted in PCI capable hospitals versus patients admitted in community hospitals

Background

The current guidelines for the management of ST-segment elevation myocardial infarction (STEMI) recommend primary percutaneous coronary intervention (pPCI) as the preferred treatment strategy if it can be conducted in a timely fashion by an experienced catheterisation team. However, because of logistical restraints, PCI can only be offered in less than 50% of European/Belgian hospitals. This has shifted the focus toward extension of PCI benefits to patients who present to community hospitals with no interventional capabilities. Several randomised trials have demonstrated that transferring STEMI patients to PCI-capable hospitals for primary PCI is safe and leads to better outcomes than administration of thrombolytic therapy at community hospitals. This has formed the basis of the development of STEMI networks with prearranged rapid transfer protocols between community hospitals and PCI centres. To validate the concept of STEMI networks in a real-world context in Belgium, more data are needed on management and outcome of an unselected community based STEMI population.
Accordingly, the current study evaluates reperfusion strategy and in-hospital mortality in community hospitals and PCI-capable hospitals in the context of a real-world nationwide STEMI network program that was started in 2007 in Belgium.

Methods:

We collected data from 25 of the 27 PCI-capable hospitals and 55 of 83 community hospitals between period of 2007 and 2012. Collection of data was carried out by electronic web-based registry that is governed by an independent software company specialised in electronic data capture solutions (Lambda-plus- website: http://www.lambdaplus.com).
A number of baseline characteristics for each patient was included which allowed to stratify the patients according to a previous validated TIMI risk score: age, gender, collapse with cardiopulmonary resuscitation (CPR), history of coronary artery disease

(CAD) or peripheral artery disease (PAD), location of infarction, total ischemic time. age, hemodynamic status on admission, history of atherovascular disease, history of hypertension or diabetes. Following types of reperfusion strategy were defined: thrombolysis (TL), percutaneous coronary intervention (PCI) or no reperfusion. In addition, for TL and for no-reperfusion patients subsequent invasive evaluation (either in the acute phase or more electively during hospitalisation) was recorded.

The primary endpoint was in-hospital death from all causes as late as 30 days after admission. Vital status was assessed in the final hospital before home discharge.

Statistical Analysis

Continuous variables are presented as the mean values with corresponding standard deviation (SD). Comparisons between groups were made with an unpaired t-test. The differences between proportions were assessed by chi-squared analysis. Independent determinants of in-hospital death were determined by means of multiple logistic regression analysis and reported as odds ratios (ORs) and 95% confidence intervals (CIs). Following factors were included in this analysis: age, gender, weight, history of CAD or PAD, arterial hypertension, diabetes mellitus, Killip class, blood pressure and heart rate on admission, infarct location, cardiac arrest with rescuscitation, total ischemic time, hospital volume as defined by the number of enrolled STEMI patients. A propensity score was used to adjust for differences in baseline characteristics between community hospital-admitted patients and PCI-capable hospital-admitted patients.(15). For all analyses, a value of $p<0.05$ was considered statistically significant.

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Results

Baseline characteristics and treatment modalities

The total study population consisted of 13516 patients. Of the total population, 5409 patients (40%) were admitted to a community hospital and 8107 (60%) to a PCI-capable hospital. The baseline characteristics of the two patient groups are depicted in table 1. Patients admitted to community hospitals were older, a higher percentage was female and had longer total ischemic time delays, but had less concomitant pathology and were hemodynamically more stable than patients admitted to PCI-capable hospitals. The overall TIMI risk score was not significantly different between both study groups: 4.3 vs. 4.2 (p=0.3). Treatment strategy was highly different between both study groups. Primary PCI was the predominant treatment strategy (93.3%) in PCI-capable centres, whereas in community hospitals, both transfer for pPCI (76%) and thrombolytic therapy (16%) was offered to patients. Fibrinolysis was given pre-hospital for 16.6% of the thrombolysis patients. Conservative therapy was offered more often to community hospitalised patients (8.2% vs.3.7%) and was mostly related to too late presentation (78%) or to severe comorbidity (14%). In community hospitalised patients, the TIMI risk score of thrombolysis patients was lower than that of pPCI patients: 3.8 ± 2.7 vs.4.1 ± 2.9 (p=0.03). The majority (68%)of the thrombolysis and conservatively managed patients underwent subsequent invasive evaluation either in the acute phase after failed thrombolysis or electively during index hospitalisation.

Table 1: Baseline patient characteristics and treatment modalities

Characteristics	Community hospital N=5409	PCI –capable hospital N = 8107	p-value
Age, y	63.7±13.5	62.6±13.1	0.0003
Man, %	72.7	77	<0.0001
Weight<67 kg, %	18.4	17.3	0.17
Previous CAD, %	16.8	19.7	0.0007
Previous PAD, %	8.8	10.3	0.03
Arterial hypertension, %	42.2	45.2	0.01
Diabetes, %	14.2	15.9	0.04
Killip Class>1, %	20.4	23.1	0.0001
Heart rate>100, %	14.0	14.5	0.05
Blood pressure<100, %	21	15	0.0001
CPR, %	8.8	11.8	<0.0001
Infarct location, %			
Anterior or LBBB	45.2	44.3	0.67
Time from symptom onset to treatment:			
< 2 h, %	23.9	24.1	
2-4 h, %	39.5	43.6	<0.0001
4-8 h, %	22.4	18.8	
8-12 h, %	7.2	6.2	
>12h, %	6.9	7	
TIMI risk score	4.3±2.9	4.2±2.9	0.29
Treatment:			
Thrombolysis, %	15.6	2.9	<0.0001
Primary PCI, %	76	93.3	
Conservative, %	8.2	3.7	

Values are represented as mean ± standard deviations or as percentages.
Abbreviations: PCI , percutaneous coronary intervention; CAD, coronary artery disease; PAD, peripheral artery disease; LBBB, left bundle branch block; TIMI, Thrombolysis in Myocardial Infarction

In-hospital mortality and its predictors

The in-hospital mortality of the total study population was 6.8% and occurred within a median of 2 days (25^{th} and 75^{th} percentiles: 0-7days) after admission.
In hospital mortality was 6.9 % in community hospitalised patients versus 6.7% in patients admitted to PCI-capable hospitals (p=0.6). After correction for differences in baseline characteristics, the adjusted odds ratio was 1.1 (95% confidence interval: 0.8-1.4).
Table 1 summarises the independent predictors of in-hospital mortality. The most important independent risk factors for in-hospital death were high age, Killip class >1, low blood pressure, high heart rate, cardiac arrest, history of peripheral artery disease (PAD), long ischemic time delay, female gender and an anterior infarction location. There were no significant differences between community hospitals versus PCI-capable centres.

Table 1: predictors of in-hospital mortality

Characteristics	OR (95% CI)
Age, y	1.05 (1.04 - 1.06)
Killip class>1	5.3 (4.1 - 6.7)
CPR	5.0 (3.9 - 6.4)
Blood pressure < 100 mmHg	2.6 (2.1 - 3.2)
Heart rate > 100bpm	1.4 (1.1 - 1.8)
Previous PAD	1.8 (1.4 - 2.4)
Female	1.4 (1.1 - 1.7)
Anterior infarct location,	1.3 (1.0 - 1.5)
Ischemic time	
4-12h vs < 4h	1.3 (1.0 - 1.7)
> 12h vs < 4h	2.0 (1.6 - 2.6)
Weight < 67 kg	1.05 (0.8 - 1.4)
Previous CAD	1.1 (0.9 - 1.4)
Arterial hypertension	1.03 (0.8 - 1.3)
Diabetes	0.98 (0.7 -1.3)
Volume < 100	0.9 (0.7-1.3)
Community hospital	1.1 (0.8 – 1.4)

Abbreviations: CAD, coronary artery disease; CI, confidence interval; PAD, peripheral artery disease; CPR, cardio pulmonary resuscitation; CAD, coronary artery disease, OR, odds ratio; PCI, percutaneous coronary intervention

DISCUSSION

The present study demonstrated that in a STEMI network, in-hospital mortality of patients admitted to community hospitals is comparable to patients admitted to PCI-capable hospitals..
The concept of a STEMI network was introduced after the publication of several randomised clinical trials demonstrating that transferring STEMI patients to PCI-capable centres for primary PCI leads to better outcomes than on-site administration of fibrinolytic therapy. However, some concerns emerged as to what extent this observed benefit could be translated into daily practice. Indeed, in those randomised trials, patients at high risk (e.g., cardiogenic shock) were excluded and the thrombolytic regime was suboptimal (i.e., no routine invasive evaluation post-thrombolysis, less use of potent adjunctive pharmacotherapy). The data of the present study, which also include high-risk patients, are reassuring, as the presumed outcome gap between PCI-capable hospitals and community hospitals seems to be resolved by the implementation of the STEMI network. The high use of pPCI (>70%) is a prerequisite for obtaining these results, as was recommended by a recent task force.

The findings of the present study may help policy makers identify the optimal number of PCI centres needed to provide high quality care to their inhabitants. Our data do not support a further increase in the number of PCI centres in urban regions in Belgium, as in these regions PCI centres are already widely available with a reasonable PCI related time delay. This is in-line with recent data that recommend that one PCI centre serves a total population of 0.3-0.8 million.(3) Increasing the number of PCI hospitals carries a risk for experience loss, which has been associated with higher mortality rates.(18)

Conclusion

The present study indicated that in the context of a STEMI network with a low threshold for invasive evaluation (e.g., >70% use of pPCI), the short term prognosis of STEMI patients admitted to community hospitals is comparable to PCI-capable hospital-admitted patients. These findings strongly support the promotion and the implementation of STEMI networks in all areas with a limited availability of PCI capable hospitals.

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