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# Mode of admission and its effect on quality indicators in Belgian STEMI patients

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**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 Belgian hospitals. This has formed the basis of the development of STEMI networks with pre-arranged rapid transfer protocols between community hospitals and PCI centres. This concept was promoted at the start of the Belgian STEMI registry in 2007.
Fast notification of the cathlab team is a prerequisite to obtain short timedelays between diagnosis and treatment. Emergency Medical Services (EMSs) may play a key role in the early recognition of ST-segment elevation myocardial infarction (STEMI) and the early notification of PCI team. This study evaluates the mode of admission in STEMI patients admitted in the period of 2012-2014 and relates it with previously defined quality indicators such as reperfusion therapy, time delays between diagnosis and treatment and in hospital mortality.

**Methods:**

We collected data from 25 of the 27 PCI-capable hospitals and 25 of 83 community hospitals between period of 2012 and 2014. 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 hypertension or diabetes. Following types of reperfusion strategy were defined: thrombolysis (TL), percutaneous coronary intervention (PCI) or no reperfusion. Finally, we evaluated the time delays between diagnosis and treatment and to the mode of admission (self referral or referral by emergency medical system (EMS).
Special attention is given to following time related issues:
Total ischemic time: time from the onset of symptoms until the initiation of reperfusion therapy (either thrombolysis or PCI).
Diagnosis-to-balloon time: time from diagnosis of STEMI until first balloon inflation

Those time items are mandatory recorded as categories (eg DTB<60 or DTB 60-90,..)
In a subset of patients (about 4500 pts) exact time points were recorded and allowed also calculation of the exact time-delays and the time between onset of pain and the diagnosis.

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 discharge.

**Statistical Analysis**

Continuous variables are presented as the mean values with corresponding standard deviation (SD). Comparisons between groups were made with an ANOVA test or with Kruskal-Wallis test for variables with a skewed distribution (cf time delays). 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, history of CAD or PAD, arterial hypertension, diabetes mellitus, Killip class>1, infarct location, cardiac arrest with resuscitation, reperfusion therapy and mode of admission. For all analyses, a value of $p<0.05$ was considered statistically significant.
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## Results

*Study population .*

Between January 1st 2012 and December 31st 2014, at total of 5984 STEMI patients were enrolled in the database. Information on admission mode was available in 5692 patients. A total of 3896 STEMI patients (68%) were referred by means of the EMS to the hospital and 1796 patients (32%) went to the hospital with their own means (self-referral). The baseline characteristics of both study populations are presented in table 1. Patients in group EMS were significantly older, presented more frequently with cardiac arrest and with high Killip class and had a higher TIMI risk score. In addition the time from onset of pain until diagnosis was much shorter in the EMS group than in the self referral group.

Table 1: baseline characteristics

| | EMS N=3896 (68%) | Self Referral N=1796 (32%) | p-value |
|---|---|---|---|
| Age | 64 ± 13 | 62 ± 13 | <0.001 |
| Male gender, % | 2915 (75%) | 1368 (76%) | 0.2 |
| AHT,% | 1612 (41%) | 790 (44% | 0.11 |
| DM,% | 568 (15%) | 269 (15%) | 0.7 |
| CAD,% | 620 (16%) | 277 (15%) | 0.7 |
| PAD,% | 315 (8%) | 143 (8%) | 0.9 |
| Anterior MI, % | 1655 (43%) | 733 (41%) | 0.3 |
| Time between onset of pain and diagnosis, min (n=4531) | 105 (IQR 57-204) | 155 (IQR 72-350) | <0.0001 |
| Killip>1,% | 880 (23%) | 272 (15%) | <0.0001 |
| CPR, % | 551 (14%) | 82 (5%) | <0.0001 |
| TIMI risk score | 3.9 ± 3.4 | 3.6 ± 2.1 | <0.001 |

*Values are represented as mean ± standard deviations or as numbers (percentages).*
*Abbreviations: AHT, arterial hypertension; CAD, coronary artery disease; CPR, cardiopulmonary rescuscitation; PAD, peripheral artery disease; DM, diabetes mellitus; IQR, interquartile range; TIMI risk score, Thrombolysis in Myocardial Infarction risk score;*

*Reperfusion therapy*

Table 2 describes reperfusion modalities and treatment time lines for both study groups. More patients within the EMS group received primary PCI (95% vs 91%.) whereas more self referral patients were not treated with any reperfusion therapy (7% vs 3%). The time interval between the diagnosis to first balloon inflation was shorter in the EMS group (median of 70min vs 75 min, p<0,001) and more patients in group EMS got primary PCI within 90 minutes (72% vs 65%, p<0.01). In view of shorter DTB times and shorter timedelay between onset of pain and diagnosis, the total ischemic time delay is much shorter in the EMS group and more patients (up to 61%) got reperfusion therapy within 4h after onset of pain as compared to 53% in the self referral group.

Table 2: reperfusion therapy and treatment delay

| | EMS N=3896 (68%) | Self Referral N=1796 (32%) | p-value |
|---|---|---|---|
| Primary PCI, %<br>Thrombolysis, %<br>No reperfusion,% | 3582 (95%)<br>52 (2%)<br>129 (3%) | 1600 (91%)<br>32 (2%)<br>124 (7%) | <0.0001 |
| DTB <90min, %<br><br>DTB, min (n=3655) | 2636/3649 (72%)<br>70 ( 45-110) | 1034/1602 (65%)<br>75 (45-120) | <0.001<br><br>0.02 |
| TIT<4h,%<br><br>TIT, min (n= 3642 ) | 2286 (61%)<br><br>195 ( 131-330) | 928 (53%)<br><br>255 (157-550) | <0.0001<br><br><0.001 |

*Values are represented as median (interquartile range) or as numbers (percentages).*
*Abbreviations: DTB, diagnosis to balloon time; PCI, percutaneous coronary intervention; TIT, total ischemic time*

*In hospital mortality*

A total of 349 (6.4%) patients died during hospitalisation with mortality rate of 7.7% in the EMS group and 3.8 % in the self referral group (p<0.0001). The high mortality in the EMS group is mainly driven by higher prevalence of CPR in the EMS group. If patients with CPR are excluded from analysis, mortality in both groups are comparable (3.8% vs 3.0%, p=0.2).
Table 3 shows the independent predictors of mortality. The most important are high age, high Killip class, CPR, diabetes, history of peripheral artery disease and no reperfusion therapy. The mode of admission did not affect the mortality.

Table 3: predictors of in hospital mortality.

| Variable | Odds ratio | 95% CI |
|---|---|---|
| age | 1,07 | 1,06 to 1,09 |
| AHT | 0,65 | 0,49 to 0,86 |
| Diabetes mellitus | 1,42 | 1,02 to 2.0 |
| PAD | 1,50 | 1,02 to 2,2 |
| PCI (vs no reperfusion) | 0,46 | 0,29 to 0,71 |
| Killip>1 | 5.87 | 4,46 to 7,72 |
| CPR | 8,33 | 6,22 to 11,15 |
| Anterior MI | 1.31 | 1.01 to 1.69 |
| Male gender | 1.13 | 0.84 to 1.51 |
| CAD | 1.18 | 0.96 to 1.63 |
| EMS | 1.33 | 0.97 to 1.85 |

*Abbreviations: AHT, arterial hypertension; CAD, coronary artery disease; CPR, cardiopulmonary rescuscitation; EMS, emergency medical system; PAD, peripheral artery disease; PCI, percutaneous coronary intervention;*

## DISCUSSION and CONCLUSIONS

The present study demonstrates that EMS is activated in almost 70% of the STEMI patients in Belgium and that the use of EMS was associated with a better adherence to guidelines as evidenced by the higher use of primary PCI , shorter diagnosis-to-balloon times and shorter total ischemic time delays.

Although the perception of the general population is that calling EMS is associated with longer treatment delays than directly transferring the patient to the hospital with own transport, our data illustrates the opposite. In fact EMS activation results in earlier diagnosis (often prehospital) and earlier initiation of the recommended reperfusion therapy (= primary PCI).

Thanks to the promotion and implementation of the concept of STEMI network in Belgium, PCI rate increased significantly over time, particularly in the community hospitals, and reached a penetration rate of >90% which is in line with European recommendations. Also the high density of PCI-capable hospitals in Belgium facilitates the use of invasive management of STEMI patients in Belgium.

In the present study EMS use was associated with 5 min decrease in door-to-balloon time and with 5-10% more patients that got primary PCI within recommended timeframe of 90min. This reduction in DTB time is remarkable as diagnosis is often made prehospital by the EMS and would therefore lead to an increase of DTB time in function of the transfer time from home to the hospital. This delay in DTB is however offset by the early notification of the cathlab team by EMS. Indeed, the preparation of the cathlab and its team can be carried out while the patients is transferred to the hospital. Once arrived in the hospital the patient can be transferred directly to the cathlab thereby bypassing the emergency room.

Although previous large scale studies have shown a positive correlation between shorter treatment delays and survival, the observed gain in treatment delay was probably too small to be translated into a mortality benefit.

Despite high density of PCI capable hospitals and the use of EMS, still about 30% of the patients received reperfusion therapy beyond 90min after diagnosis. The reason for this prolonged diagnosis to balloon time remains speculative and requires more in depth analysis of treatment time delays. However, it is conceivable that the emergency medical system (EMS) capacity was not adapted to the increased need for transferring patient to PCI capable hospitals. Indeed, there are still hospitals without PCI facilities that rely on the PCI hospital's MUG/SAMU facilities to pick up the patients, obviously tremendously adding

to the delays. The most optimal transfer policy is the direct transfer of STEMI patients (from home or from community hospital) to the nearest PCI capable hospital but more logistic support to EMS services will be needed to achieve this goal.
The present findings are an argument for continued monitoring of the quality of care for STEMI patients. In view of the suboptimal time delay results, specific time delay indicators, such as time period between arrival in PCI hospital and the balloon inflation, are developed and will allow us to better define gaps in transfer policy in Belgium.

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**References**

Van de Werf F, Bax J, Betriu A, Blomstrom-Lundqvist C, Crea F, Falk V, Filippatos G, Fox K, Huber K, Kastrati A, Rosengren A, Steg PG, Tubaro M, Verheugt F, Weidinger F, Weis M. Management of acute myocardial infarction in patients presenting with persistent ST-segment elevation: the Task Force on the Management of ST-Segment Elevation Acute Myocardial Infarction of the European Society of Cardiology. *Eur Heart J* 2008;**29**(23):2909-2945.

Brown Jason P, MDa, Ehtisham Mahmud, et al. Effet of Prehospital 12-Lead Electrocardiogram on Activation of the Cardiac Catheterization Laboratory and Door-to-Balloon Time in ST-Segment elevation acute myocardial infarction. Am J Cardiol.2008;101: 158-161

Pinto DS, Kirtane AJ, Nallamothu BK et al. Hospital delays in reperfusion for ST-elevation myocardial infarction: implications when selecting a reperfusion strategy. *Circulation* 2006;114:2019-2025.

Derek Y.F. So, Andrew C.T Ha, Michele A, et al. Comparaison of Mortality in Patients With ST-elevation Myocardial Infarction arriving by Emergency Medical Services Versus Self-Transport (from the Prospective Ottawa Hospital STEMI Registry). Am J Cardiol. 2006;97:458-461