

Primary angioplasty in Portugal: door-to-balloon time is not a good performance index

Hélder Pereira*, MD, FESC, FACC

Cardiology Department, Hospital Garcia Orta, Almada, Portugal

KEYWORDS

- acute myocardial infarction
- primary angioplasty
- stent

Abstract

Aims: Despite primary angioplasty being the recommended treatment for patients with acute myocardial infarction with ST-elevation, recent studies have shown a great heterogeneity in the access to this form of treatment in Europe. The project “Stent for Life”, an initiative of the European Society of Cardiology which Portugal joined in February 2011, aims to improve this situation.

Methods and results: The objective of this study was to re-evaluate the basic Portuguese performance indicators for primary angioplasty. A national survey called “Moment Zero” was implemented for a one-month period for this purpose. Nineteen Portuguese centres of interventional cardiology, where primary angioplasty is carried out, were invited to participate in this study. From 9th May to 8th June 2011, 14 centres participated in this study and 185 patients were included with a mean age of 62±14 years, of which 76.8% were male. 17.5% of the patients presented with a medical history of diabetes mellitus, 8.4% had previous percutaneous coronary intervention, 7.6% myocardial infarction and 1.1% coronary artery bypass surgery. Only 29% of the patients used the single national number for medical emergencies (112) to call for support. The median patient delay was 120 (73-240) minutes. The median pre-hospital transportation system delay was 104 (73-240) minutes. The median door-to-balloon delay (D2B) was 64 (30-110) minutes and was not significantly different between patients who contacted the National Institute for Medical Emergency (INEM) and patients who did not contact this service: 69 (30-109) minutes versus 60 (30-111) minutes. In 56% of the cases, patients entered a local hospital before transferring to a hospital with primary angioplasty facilities. The time between the admission to the local hospital and admission to a hospital with an interventional cardiology unit was 109 (73-173) minutes.

Conclusions: The main barriers to a better performance of the primary angioplasty programme in Portugal, as revealed by “Moment Zero”, are the low number of patients who contacted the INEM and the high number of patients who attended centres without interventional cardiology units, resulting in long delays spent in secondary transportation to the institutions with such services. The D2B delay, although close to the 90 minutes recommended by the guidelines, is not a good indicator of the overall performance of primary angioplasty in Portugal.

*Corresponding author: Cardiology Department, Hospital, Garcia de Orta, Av Prof Torrado Silva, 2800 Almada Portugal.
E-mail: helder@netcabo.pt

Introduction

Several randomised clinical trials¹⁻⁵ and meta-analyses⁶ have shown that primary angioplasty, also known as primary percutaneous coronary intervention (p-PCI), is superior to fibrinolysis in reducing mortality as well as the risk of reinfarction and stroke. The European Society of Cardiology recommends reperfusion by p-PCI as soon as possible in patients with acute myocardial infarction with ST-elevation (STEMI), in the first 12 hours after onset of symptoms and with persistent ST-elevation (or new left bundle branch block) in the 12-lead ECG. The recommended time from the first medical contact (FMC) until p-PCI should be ≤ 2 hours for any STEMI and ≤ 90 min in patients symptomatic for less than two hours with extensive anterior STEMI and low haemorrhagic risk^{7,8}.

Despite having a reasonably well-established primary angioplasty network, Portugal was one of the countries in Western Europe with lower rates of p-PCI per million inhabitants at the beginning of this millennium^{9,10}. The project “Stent for Life”, an initiative of the European Society of Cardiology which Portugal joined in February 2011, aims to improve this situation¹¹.

In the absence of national data which would allow a thorough assessment from the starting point of the disease (i.e., a national prospective registry which would include all Portuguese patients with STEMI), a prospective registry, defined as “Moment Zero”, was designed with the purpose of assisting the Stent for Life Task Force in the launch of an action plan, aimed at the fields where the performance deficits would be most critical.

Methods

The study was based on a survey sent to all centres of mainland Portugal with an interventional cardiology unit active 24 hours/7 days and which follow p-PCI protocols. The objective was to register, for one month (from 9th May to 8th June 2011), all catheterised patients with a presumed diagnosis of STEMI up to 12 hours after the onset of symptoms.

The purpose of the survey was to determine if the patient did or did not use the single national number for medical emergencies (112) in order to obtain direct assistance from the National Institute for Medical Emergency (INEM), as well as the transportation used to attend the centre for primary angioplasty. It was also noted if the patient attended another hospital before attending an institution with p-PCI.

The survey also aimed to register the observed time periods between the onset of pain and the primary angioplasty treatment: 1) patient delay (time between the onset of pain and the moment of first medical contact - FMC); 2) pre-hospital transportation delay (time between FMC and hospital attendance); 3) local hospital delay (time between attendance at the local hospital and attendance at the hospital with p-PCI facilities); 4) door-to-balloon (D2B) delay (time between attendance at the hospital with p-PCI and application of the first vascular opening device in the lesion that caused the infarction).

System delay was defined as the sum of transport delay and D2B; for cases where the patient attended a local hospital this period was also

added. For patients without FMC who presented directly at a hospital with p-PCI facilities, the system delay was equal to D2B delay.

Treatment delay was defined as the time between the onset of symptoms and application of the first vascular opening device in the lesion responsible for the infarction (sum of patient delay and system delay).

No data were collected regarding the clinical outcomes of the performed interventions.

Statistical analysis

Qualitative variables were summarised by counts and percentages and quantitative variables by median and interquartile range, unless otherwise specified (e.g., age).

The Mann-Whitney non-parametric test was performed to compare the groups of patients who did and did not contact INEM in relation to quantitative variables.

Statistical tests were two-pronged considering a significance level of 5%.

Statistical analysis was performed through the software IBM® SPSS® Statistics 18.

Results

Of the 19 centres which perform p-PCI in mainland Portugal, 14 participated in this study (representing 79% of the patients treated by this procedure in 2011) and included data from 185 patients, which represented the total number of patients assessed and treated during that period. **Table 1** presents demographic data and clinical background information. Patients' mean age was 62±14 years and 76.8% were male. In 90.8% of the patients the diagnosis of STEMI was confirmed and in 4.9% coronarography did not show significant lesions (**Table 2**).

Only 29% of the patients used the national single number for medical emergencies to request assistance. This single number allows direct access to the INEM, which has the responsibility for pre-hospital transportation.

The median patient delay was 120 (73-240) minutes. There was a statistically significant difference ($p=0.002$) between the group of patients who contacted the INEM for support and the group of patients who did not: median of 98 (60-148) minutes vs. 166 (89-279) minutes.

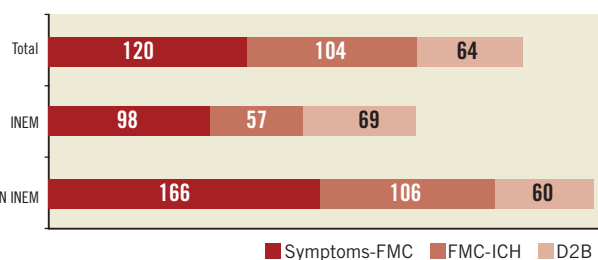
Table 1. Demographics and clinical background.

Baseline	
Age ($\bar{x}\pm$ sd), in years	61.7+13.5
Male	76.8% (142/185)
Background	
PCI	8.4% (15/179)
CABG	1.1% (2/177)
DM	17.5% (30/171)
Prior MI	8.1% (14/173)
\bar{x} : mean; sd: standard deviation; PCI: percutaneous coronary intervention; CABG: coronary artery bypass graft; DM: diabetes mellitus; Prior MI: prior myocardial infarction	

Table 2. Coronary angiography data.

Diagnosis after medical team activation	
Myocardial infarction with ST-elevation	90.8% (168/185)
Coronary arteries without significant lesions	4.9% (9/185)
Myopericarditis	1.6% (3/185)
Takotsubo cardiomyopathy	1.6% (3/185)
Activation of the medical team without performing coronarography	1.1% (2/185)

The median pre-hospital transportation delay was 104 (60-153) minutes, while the median D2B delay was 64 (30-110) minutes. D2B delay was not significantly different between patients who contacted the INEM for assistance and patients who did not: median of 69 (39-109) minutes vs. 60 (30-111) minutes. These results are shown in **Figure 1**.

**Figure 1. Treatment delay.**

INEM: called the National Medical Emergency Institute; N INEM: did not call the National Medical Emergency Institute; Symptoms-FMC: beginning of symptoms to first medical contact (patient delay); FMC-ICH: first medical contact to interventional cardiology hospital (pre-hospital transportation delay); D2B: door-to-balloon delay

In 56% of cases, patients attended a local hospital before attending the hospital with p-PCI facilities. The median local hospital delay was 109 (73-173) minutes.

The median system delay was 110 (75-166) minutes. This time was significantly lower in patients who were directly transported to a centre with an interventional cardiology unit in comparison with patients who had a first medical contact in a hospital without that unit (88 vs.130; $p=0.002$). System delay showed a lower trend in the group of patients who contacted the INEM for assistance compared with the group who did not: 84 (69-172) minutes vs.115 (81-164) minutes, $p=0.099$.

The median treatment delay was 276 (179-46) minutes, with a significantly lower time in the group of patients who contacted INEM (206 vs. 312; $p=0.024$). Treatment delay in the subgroup of patients who were previously assisted in a hospital without an interventional cardiology unit was significantly higher than the subgroup of patients that did not attend a local hospital (338 vs. 226; $p=0.003$).

Discussion

PATIENT DELAY

This study highlights the low percentage of patients who used the national single number for medical emergencies to request assistance (29%). These results confirm the official data published by the Portuguese Ministry of Health in 2009 and 2010, in which only 23% of patients resorted to the INEM through this contact number¹². By means of a public advertising campaign, the Stent for Life Task Force in Portugal has been focusing its attention on raising awareness of the symptoms of myocardial infarction and the proper actions to be carried out in order to obtain timely and adequate treatment.

An important aspect to be addressed by this campaign is to reduce the proportion of patients who attend the hospital more than 12 hours after the onset of symptoms. According to the National Registry of Acute Coronary Syndromes, from 2002 to 2008⁹, of the 37.3% of patients not submitted to any revascularisation procedure, the cause in 55% of cases was attendance at the hospital more than 12 hours after the onset of symptoms. One final aspect revealed by this study was a long time period from the onset of symptoms to FMC (median of 120 minutes).

The performance of different media campaigns has provided conflicting results regarding the impact of patient delay time¹³. The only campaign which evaluated the effect of this period on mortality found no difference in mortality during the year of the campaign compared with the previous period¹⁴.

SYSTEM DELAY

The median system delay was 110 minutes, a value within the recommended guidelines (which is 120 minutes)^{7,15}. However, the analysis of system delay in the different ways a patient arrives at the primary angioplasty centre suggests that it is possible to obtain a lower system delay if the patient were to be directly transported to a centre with an interventional cardiology unit without having passed through a centre without that unit (88 vs.130 minutes) and will possibly be lower if the initial contact was through the INEM (84 vs.115 minutes).

Pre-hospital transportation delay was lower in patients who contacted the INEM, compared to patients who did not (57 min vs.106 minutes). At present, the INEM vehicles are equipped with telemetry and a physician and a nurse, who monitor the patient during transportation, contact the attending cardiologist at the hospital with an interventional cardiology unit directly by phone. This allows the timely preparation of the angiography room for the arrival of the patient without needing to pass through the emergency room.

The first initiatives designed to improve the performance of p-PCI were mainly focused on intra-hospital timings. D2B Alliance considered the D2B delay “a key indicator of quality of care in STEMI patients treated with p-PCI”. Recently, several authors have highlighted the system delay as the indicator of service quality and clinical outcomes¹⁶⁻¹⁸. This study demonstrates that the isolated evaluation of the D2B delay is not a good indicator of the global

performance of p-PCI. Overall, the median period was 64 minutes, not substantially different from guideline recommendations^{7,15}. For D2B delay, no significant differences were observed between patients who contacted the INEM (median of 69 minutes) and patients who did not (median of 60 minutes).

Unequivocally, the high number of patients who attended local hospitals before being admitted to a hospital with p-PCI (56%) was the main cause for the long time period between onset of symptoms and hospital attendance. An important barrier to overcome is the secondary transportation between local hospitals and centres with p-PCI facilities. This transportation is not the responsibility of the INEM, who are only accountable for pre-hospital transportation. There is no national system defined for this type of transportation and, once the patient is seen by a physician in a hospital, the level of care provided by healthcare professionals must not be reduced. Therefore, further transportation must be carried out in an ambulance, with the supervision of a physician. Due to the shortage of physicians in the emergency units, this procedure leads to prolonged local hospital delays.

These results are in accordance with other, single-centre studies, carried out in Portugal^{19,20}.

SUMMARY

The association between the time of myocardial ischaemia and STEMI prognosis is clearly established. It is thus a priority to obtain myocardial perfusion within the shortest time interval. Through its “know-how”, the Stent for Life Initiative may be of great assistance in improving the performance of p-PCI²¹. The main barriers to overcome include the low number of patients who contact the single national number for medical emergencies, as well as the high number of patients who attend local hospitals without p-PCI facilities, with consequential high delays in the secondary transportation to the interventional centres.

The D2B delay, despite being close to the 90 minutes recommended by the guidelines, is not a good indicator of the overall performance of p-PCI in Portugal.

Acknowledgements

The author of this study would like to acknowledge the support given by Dr Sofia de Mello (Project Manager of SFL Portugal) and Dr Ernesto Pereira (Task Force Member) for providing valuable assistance in data collection and analysis.

Participating centres: Hospital Braga (Dr João Costa), Hospital S. João (Dr João Carlos Silva), Hospital Santo António (Dr Henrique Carvalho), Centro Hospitalar Vila Nova de Gaia (Dr Vasco Gama Fernandes), Hospital de Viseu (Dr João Pipa), Centro Hospitalar de Coimbra (Dr Leitão Marques), Hospital de Leiria (Dr João Morais), Hospital Fernando da Fonseca (Dr Pedro Farto e Abreu), Hospital de Santa Maria (Dr Pedro Canas da Silva), Hospital Pulido Valente (Dr Pedro Cardoso), Hospital de Santa Marta (Dr Rui Ferreira), Hospital Curry Cabral (Dr Luís Mourão), Hospital Garcia de Orta (Dr Hélder Pereira), Hospital Setúbal (Dr Ricardo Santos), Hospital de Évora (Dr Lino Patrício e Dr Renato Fernandes) and H de Faro (Dr Victor Brandão).

Conflict of interest statement

The author has no conflict of interest to declare.

References

- Zijlstra F, de Boer MJ, Hoorntje JC, Reiffers S, Reiber JH, Suryapranata H. A comparison of immediate coronary angioplasty with intravenous streptokinase in acute myocardial infarction. *N Eng J Med*. 1993;328:680-4.
- Zijlstra F, Hoorntje JC, de Boer MJ, Reiffers S, Miedema K, Ottervanger JP, van 't Hof AW, Suryapranata H. Long-term benefit of primary angioplasty as compared with thrombolytic therapy for acute myocardial infarction. *N Eng J Med*. 1999;341:1413-9.
- Widimský P, Groch L, Zelízko M, Aschermann M, Bednár F, Suryapranata H. Multicentre randomized trial comparing transport to primary angioplasty vs immediate thrombolysis vs combined strategy for patients with acute myocardial infarction presenting to a community hospital without a catheterization laboratory. The PRAGUE study. *Eur Heart J*. 2000;21:823-31.
- Widimský P, Budesínský T, Vorác D, Groch L, Zelízko M, Aschermann M, Branny M, Stásek J, Formánek P. Long distance transport for primary angioplasty vs immediate thrombolysis in acute myocardial infarction. Final results of the randomized national multicentre trial--PRAGUE-2. *Eur Heart J*. 2003;24: 94-104.
- Andersen HR, Nielsen TT, Rasmussen K, Thuesen L, Kelbaek H, Thayssen P, Abildgaard U, Pedersen F, Madsen JK, Grande P, Villadsen AB, Krusell LR, Haghfelt T, Lomholt P, Husted SE, Vigholt E, Kjaergard HK, Mortensen LS. A comparison of coronary angioplasty with fibrinolytic therapy in acute myocardial infarction. *N Eng J Med*. 2003;349:733-42.
- Keeley E C, Boura JA, Grines CL. Primary angioplasty versus intravenous thrombolytic therapy for acute myocardial infarction: a quantitative review of 23 randomised trials. *Lancet*. 2003;361:13-20.
- 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;29:2909-45.
- Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS), European Association for Percutaneous Cardiovascular Interventions (EAPCI), Wijns W, Kolh P, Danchin N, Di Mario C, Falk V, Folliguet T, Garg S, Huber K, James S, Knuuti J, Lopez-Sendon J, Marco J, Menicanti L, Ostojic M, Piepoli MF, Pirlet C, Pomar JL, Reifart N, Ribichini FL, Schaliij MJ, Sergeant P, Serruys PW, Silber S, Sousa Uva M, Taggart D. Guidelines on myocardial revascularization. *Eur Heart J*. 2010;31:2510-55.
- Santos J, Aguiar C, Gavina C, Azevedo P, Morais J. Registo Nacional de Síndromes Coronárias Agudas da Sociedade Portuguesa de Cardiologia. *Rev Port Cardiol*. 2009;28:1465-500.

10. Widimsky P, Wijns W, Fajadet J, de Belder M, Knot J, Aaberge L, Andrikopoulos G, Baz JA, Betriu A, Claeys M, Danchin N, Djambazov S, Erne P, Hartikainen J, Huber K, Kala P, Klinceva M, Kristensen SD, Ludman P, Ferre JM, Merkely B, Milicic D, Morais J, Noc M, Opolski G, Ostojic M, Radovanovic D, De Servi S, Stenestrand U, Studencan M, Tubaro M, Vasiljevic Z, Weidinger F, Witkowski A, Zeymer U. Reperfusion therapy for ST elevation acute myocardial infarction in Europe: description of the current situation in 30 countries. *Eur Heart J*. 2010;31:943-57.
11. Widimsky P, Fajadet J, Danchin N, Wijns W. "Stent 4 Life". Targeting PCI at all who will benefit the most. A joint project between EAPCI, Euro-PCR, EUCOMED and the ESC Working Group on Acute Cardiac Care. *EuroIntervention*. 2009;4:555-7.
12. <http://www.acs.min-saude.pt/pns/en/cardiovascular-diseases/> assessed in 15th February 2012.
13. Blohm MB, Hartford M, Karlson BW, Luepker RV, Herlitz J. An evaluation of the results of media and educational campaigns designed to shorten the time taken by patients with acute myocardial infarction to decide to go to hospital. *Heart*. 1996;76:430-4.
14. Blohm M, Herlitz J, Hartford M, Karlson BW, Risenfors M, Luepker RV, Sjölin M, Holmberg S. Consequences of a media campaign focusing on delay in acute myocardial infarction. *Am J Cardiol*. 1992;69:411-3.
15. Antman EM, Hand M, Armstrong PW, Bates ER, Green LA, Halasyamani LK, Hochman JS, Krumholz HM, Lamas GA, Mullany CJ, Pearle DL, Sloan MA, Smith SC Jr, Anbe DT, Kushner FG, Ornato JP, Pearle DL, Sloan MA, Jacobs AK, Adams CD, Anderson JL, Buller CE, Creager MA, Ettinger SM, Halperin JL, Hunt SA, Lytle BW, Nishimura R, Page RL, Riegel B, Tarkington LG, Yancy CW. 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. *J Am Coll Cardiol*. 2008;51:210-47.
16. De Luca G, Suryapranata H, Ottervanger JP, Antman EM. Time delay to treatment and mortality in primary angioplasty for acute myocardial infarction: every minute of delay counts. *Circulation*. 2004;109:1223-5.
17. Terkelsen CJ, Sørensen JT, Maeng M, Jensen LO, Tilsted HH, Trautner S, Vach W, Johnsen SP, Thuesen L, Lassen JF. System delay and mortality among patients with STEMI treated with primary percutaneous coronary intervention. *JAMA*. 2010;304:763-71.
18. Nielsen PH, Terkelsen CJ, Nielsen, TT, Thuesen L, Krusell LR, Thyssen P, Kelbaek H, Abildgaard U, Villadsen AB, Andersen HR, Maeng M. System Delay and Timing of Intervention in Acute Myocardial Infarction (from the Danish Acute Myocardial Infarction-2 [DANAMI-2] Trial). *Am J Cardiol*. 2011;108: 776-81.
19. Trigo J, Gago P, Mimoso J, Santos W, Marques N, Gomes V. Tempo de demora intra-hospitalar após triagem de Manchester nos Enfartes Agudos do Miocárdio com elevação de ST. *Rev Port Cardiol*. 2008;27:1251-9.
20. Ribeiro S, Gaspar A, Rocha S, Nabais S, Azevedo P, Salgado A, Pereira MA, Correia A. Preditores de demora pré-hospitalar em doentes com enfarte agudo do miocárdio com elevação do segmento ST. *Rev Port Cardiol*. 2010;29:1521-32.
21. <http://www.stentforlife.pt> assessed in 15th February 2012