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Evaluation of a 'color coding' system for the assessment of patients undergoing primary percutaneous coronary intervention

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ABSTRACT

Aims: The reduction of delay times as well as the rate of false alarms (FA) have become some of the main points of the different infarction networks. We propose a simple way of classifying patients derived for primary PCI (pPCI) into well-defined simple groups by colors, where we can assess real delays of each clinical presentation, define the FA and, furthermore, establish their immediate and short term prognosis.
Methods and results: Prospective study of STEMI consecutive patients derived for pPCI during 2014. Patients were categorized into one of the 3 predesigned groups [(i) Green: diagnostic-ECG with compatible clinical presentation for pPCI; (ii) Yellow: LBBB, pacemaker rate or non-diagnostic ECG; and (iii) Red: very complex patients], always before performing the angiography in 518 patients. Delay times were highest in the Yellow group, with much longer first medical contact (FMC) to balloon time (median Green 118′; Yellow 163′; Red 130′; $p < 0.001$) mainly due to higher times from the first medical contact to the diagnosis and team activation (median Green 30′; Yellow 70′; Red 39′; $p < 0.001$). In the whole cohort, pPCI was performed in 80.2% of patients, with 11.9% of FA. The Green group had only a 2.5% FA rate, in contrast to the Yellow group where FA were 43.2%.
Conclusions: This simple classification differentiates the 3 very clear groups in which delay times and prognosis are very different. This classification allows us to measure, evaluate and compare the performance of each of our pPCI networks with others and within different periods of times.

1. Introduction

The current management of ST-segment elevation myocardial infarction (STEMI) is aimed at performing primary angioplasty (pPCI) as the best therapeutic option with the focus on early diagnosis and prompt revascularization and with optimal standards defined by door-to-balloon and call-to-balloon times [1,2]. This focus on timely revascularization has led to the creation of PCI networks between different hospitals, sometimes defining "heart attack centers" that allow diagnosis and treatment of patients with STEMI, in order to optimize medical care, reduce delays and increase the proportion of patients undergoing reperfusion with the aim of improving clinical outcomes.

One major problem in assessing the performance of a healthcare pPCI network is the number of patients for which the pPCI alert is activated. However, there are diagnostic errors (i.e. false positives). Should referral criteria be very strict, we would increase the sensitivity of the diagnosis but at the expense of leaving some patients untreated. The majority of networks recommend flexibility when accepting patients for pPCI, so as to avoid non-revascularized patients, knowing that such patients will increase the false positives.

The proportion of catheterization laboratory "false alarms" (FA) has been proposed as an indicator of the quality of primary angioplasty programs complementary to other parameters such as door-to-balloon time or mortality. However, the confusion of the diagnosis with that of other entities that involve elevation of the ST segment can lead to an unnecessary emergency coronary angiography, a circumstance that increases health care costs and exposes the patient to the risks of the procedure [3]. In previous studies, the prevalence of FA has ranged between 2% and 36% [4–8].

A major problem of treatment in 'real world' STEMI networks is that not everything is so clear or measurable. Any pPCI network delays are made up of large variations which are influenced by multiple variables, including the place of the first medical contact, the clinical setting, the clarity of the ECG and even the skill of the physician at the time of

Abbreviations: STEMI, ST-segment elevation myocardial infarction; pPCI, primary percutaneous coronary intervention; FA, false alarms; LBBB, left bundle branch block morphology; IT, total ischemic time; FMCTB, first-medical-contact-to-balloon; IQR, interquartile range; IADP, ADP inhibitor.

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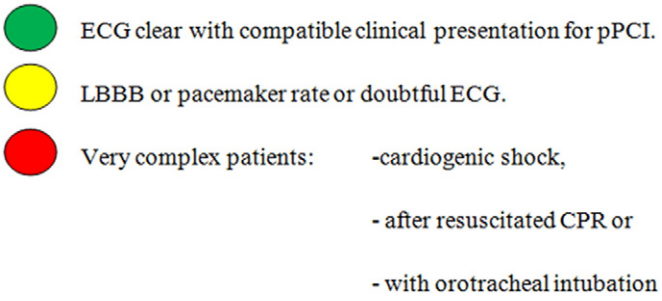

Fig. 1. Color code classification.

diagnosis [9–11]. In all reported series of pPCI, delay time ranges are huge and can vary from a few minutes in clear diagnosis of very florid infarcts up to many hours in non-specific or atypical settings.

Also, many series of pPCI patients with suggestive clinical and ECG with left bundle branch block morphology (LBBB) or pacemakers are often included, which may represent a heterogeneous group. The European Guidelines [1] widely discuss cases in which the ECG diagnosis may be more difficult although nevertheless deserve prompt management.

In this pPCI Registry, we have implemented a very simple way of classifying patients by colors (Fig. 1): (i) Green: diagnostic ECG with compatible clinical presentation for pPCI; (ii) Yellow: LBBB, pacemaker rate or non-diagnostic ECG with a suspicion of myocardial infarction and reperfusion therapy needs to be initiated as soon as possible; and (iii) Red: very complex patients (cardiogenic shock, after cardiac pulmonary resuscitation (CPR), patients with orotracheal intubation) with suspected STEMI.

Our aim was to classify patients into well-defined simple groups where we can assess real delays of each clinical presentation, as well as define the false positives and FA alerts, as well as their immediate and short term prognosis. The objective of this paper is to present our one year data base on following the implementation of this simple clinical categorization, in relation to patient profile and outcomes.

2. Methods

This was a prospective single center cohort study of STEMI patients derived for pPCI. The inclusion period was Jan. 1st, 2014 to Dec. 31st, 2014. All patients with a clinical setting compatible and/or ECG diagnostic o suggesting infarction, for whom the pPCI alert was activated during this period, were included.

Our hospital has been carrying out primary PCI in a systematic manner in all patients diagnosed with STEMI in our area and its surroundings. The area to which we provide 24 h coverage has a total of 1,000,000 inhabitants (that includes 2 tertiary hospitals and 5 regional hospitals). During office hours (from 8.00 am to 3.00 pm), there are other 2 open cardiac catheterization laboratories which admit pPCI patients.

In our network, the catheterization laboratory is activated by a single call at the moment of the diagnosis and candidates for primary PCI are admitted directly to the cath-lab, bypassing the Emergency Department and/or Intensive Coronary Care Unit. Patients diagnosed with STEMI are transferred to our hospital with emergency medical services (ambulance) provided with a doctor and a nurse. The interventional cardiology team is made up by 5 senior interventional cardiologists with a large experience in pPCI.

All patients are transferred for pPCI and, if there are no serious incidents, by the time that revascularization is complete the patient is returned to the Intensive Care Unit of their hospital of origin. All consecutive patients with suspected STEMI referred to our Unit to perform pPCI were prospectively recorded into our pPCI registry. When they reached the cardiac catheterization laboratory, the responsible interventional cardiologist categorized the patients into one of the 3 predesigned groups (Green/Yellow/Red), according to the ECG and clinical presentation and always before performing the angiography and procedure.

Table 1
Patient demography.

	Total	Green	Yellow	Red	p
Incidence	518	361 (69.7%)	111 (21.4%)	46 (8.9%)	
Age	62.7	61.7 ± 12.9	64.4 ± 14.5	65.9 ± 12.1	0.038
Male	404 (78.0%)	280 (77.6%)	90 (81.1%)	34 (73.9%)	0.576
Hypertension	261 (50.4%)	179 (49.6%)	63 (56.8%)	19 (41.3%)	0.182
Diabetes	120 (23.2%)	74 (20.5%)	34 (30.6%)	12 (26.7%)	0.074
Dyslipidemia	174 (33.6%)	119 (33.0%)	45 (40.5%)	10 (21.7%)	0.068
Current smoking	204 (39.4%)	162 (44.9%)	31 (27.9%)	11 (24.4%)	<0.001
Prior MI	47 (9.1%)	21 (5.8%)	21 (18.9%)	5 (10.9%)	<0.001
Prior PCI	44 (8.5%)	24 (6.6%)	15 (13.5%)	5 (10.9%)	0.063
Prior CABG	9 (1.7%)	6 (1.7%)	2 (1.85%)	1 (2.2%)	0.962
Culprit vessel					<0.001
LAD	185 (42.0%)	150 (43.5%)	24 (38.7%)	11 (32.4%)	
LCX	67 (15.2%)	41 (11.9%)	18 (29.0%)	8 (23.5%)	
RCA	185 (42.0%)	153 (44.3%)	18 (29.0%)	14 (41.2%)	
LM	4 (0.9%)	1 (0.3%)	2 (3.2%)	1 (2.9%0029	
Multiple vessel disease	206 (44.9%)	37 (50%)	37 (50%)	21 (55.3%)	0.208
Pre-procedural TIMI flow (if pPCI was performed)					<0.001
0	336 (81.6%)	284 (84.3%)	27 (58.7%)	25 (86.2%)	
1	8 (1.9%)	7 (2.1%)	0	1 (3.4%)	
2	26 (6.3%)	18 (5.3%)	7 (15.2%)	1 (3.4%)	
3	42 (10.2%)	28 (8.3%)	12 (26.1%)	2 (6.9%)	
Post-procedural TIMI flow 3	389 (94.4%)	325 (96.4%)	40 (87.0%)	35 (82.8%)	0.004
Radial access	426 (82.9%)	323 (89.7%)	95 (85.6%)	8 (18.6%)	<0.001
Use of DES	61.8%	190 (59.9%)	37 (68.5%)	21 (70.0%)	0.308
Number of stents	1.3 ± 0.7	1.3 ± 0.7	1.5±0.8	1.4 ± 0.9	0.261
Pretreatment with acetylsalicylic acid	461 (89.1%)	336 (93.1%)	96 (86.5%)	29 (63.0%)	<0.001
Pretreatment with IADP	388 (74.9%)	291 (80.6%)	76 (68.5%)	21 (45.7%)	0.163
GP IIb/IIIa inhib	190 (36.7%)	165 (45.7%)	9 (8.1%)	16 (34.8%)	<0.001

MI: myocardial infarction; LAD: left anterior descending artery; LCX: left circumflex artery; RCA: right coronary artery; LM: left main coronary artery; TIMI: thrombolysis in myocardial infarction; IADP: ADP inhibitor; GP IIb/IIIa inhib: glycoprotein IIb/IIIa inhibitor.