International Journal of Cardiology 231 (2017) 31–35

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Characterization and referral patterns of ST-elevation myocardial infarction patients admitted to chest pain units rather than directly to catherization laboratories. Data from the German Chest Pain Unit Registry

Frank P. Schmidt [a,1], Andrea Perne [a,1], Matthias Hochadel [b], Evangelos Giannitsis [c], Harald Darius [d], Lars S. Maier [e], Claus Schmitt [f], Gerd Heusch [g], Thomas Voigtländer [h], Harald Mudra [i], Tommaso Gori [a,j], Jochen Senges [b], Thomas Münzel [a,*], for the German Chest Pain Unit Registry:

[a] Zentrum für Kardiologie, Kardiologie 1, Johannes Gutenberg-University Mainz, Mainz, Germany
[b] Foundation Stiftung Institut für Herzinfarktforschung, Ludwigshafen, Germany
[c] 3rd Department of Medicine, University Hospital Heidelberg, Heidelberg, Germany
[d] Department of Cardiology, Angiology and Intensive Care Medicine, Vivantes-Klinikum Neukölln, Berlin, Germany
[e] 2nd Department of Medicine, University Hospital of Regensburg, Regensburg, Germany
[f] Clinic for Cardiology and Angiology, Municipal Hospital Karlsruhe, Karlsruhe, Germany
[g] Institute for Pathophysiology, West German Heart and Vascular Center, University School of Medicine, Essen, Germany
[h] CCB, Cardioangiologisches Centrum Bethanien, Frankfurt am Main, Germany
[i] Department of Cardiology, Pneumology and Internal Intensive Care Medicine, Klinikum Neuperlach, Städtisches Klinikum München GmbH, Munich, Germany
[j] Deutsches Zentrum für Herz- Und Kreislaufforschung, Standort Rhein, Mainz, Germany

ARTICLE INFO

Article history:
Received 23 September 2016
Received in revised form 29 November 2016
Accepted 5 December 2016

Keywords:
Chest pain unit
STEMI
Pre-hospital ECG
Critical time intervals
Guideline adherence

ABSTRACT

Background: Direct transfer to the catheterization laboratory for primary percutaneous coronary intervention (PCI) is standard of care for patients with ST-segment elevation myocardial infarction (STEMI). Nevertheless, a significant number of STEMI-patients are initially treated in chest pain units (CPUs) of admitting hospitals. Thus, it is important to characterize these patients and to define why an important deviation from recommended clinical pathways occurs and in particular to quantify the impact of deviation on critical time intervals.
Methods and results: 1679 STEMI patients admitted to a CPU in the period from 2010 to 2015 were enrolled in the German CPU registry (8.5% of 19,666). 55.9% of the patients were delivered by an emergency medical system (EMS), 16.1% transferred from other hospitals and 15.2% referred by a general practitioner (GP). 12.7% were self-referrals. 55% did not get a pre-hospital ECG. Compared to the EMS, referral by GPs markedly delayed critical time intervals while a pre-hospital ECG demonstrating ST-segment elevation reduced door-to-balloon time. When compared to STEMI patients ($n = 21{,}674$) enrolled in the ALKK-registry, CPU-STEMI patients had a lower risk profile, their treatment in the CPU was guideline-conform and in-hospital mortality was low (1.5%).
Conclusions: CPU-STEMI patients represent a numerically significant group because a pre-hospital ECG was not documented. Treatment in the CPU is guideline-conform and the intra-hospital mortality is low. The lack of a pre-hospital ECG and admission via the GP substantially delay critical time intervals suggesting that in patients with symptoms suggestive an ACS, the EMS should be contacted and not the GP.

1. Introduction

The treatment of the ST-elevation myocardial infarction (STEMI) has evolved during the last decades, leading to an impressive reduction in short- and long-term mortality [1].

Since the extent of myocardial injury and long-term clinical outcomes are directly related to the duration of ischemia, early reperfusion is the main goal of all treatment efforts in patients presenting with ST-elevation myocardial infarction (STEMI). Both ESC and ACCF/AHA guidelines recommend primary percutaneous intervention (PCI) for reperfusion if performed by an experienced team within 120 min after first medical contact [1,2]. Thus, pre-hospital diagnosis by an electrocardiogram (ECG) and a subsequent direct transport to the catheterization laboratory bypassing in-hospital emergency units are strongly recommended [1,2].

* Corresponding author at: Medical Clinic for Cardiology, Angiology and Intensive Care, Langenbeckstrasse 1, 55131 Mainz, Germany.
E-mail address: tmuenzel@uni-mainz.de (T. Münzel).
[1] F.P. Schmidt and A. Perne contributed equally to this manuscript.

http://dx.doi.org/10.1016/j.ijcard.2016.12.017
0167-5273/

Efforts to reduce door-to-balloon times have been also successfully implemented, leading to marked reductions of these critical time intervals in the last decades [3,4].

In contrast, chest pain units (CPU) have been established for the work-up of patients with presumed acute coronary syndrome (ACS) when the ACS is not yet diagnosed [5]. Since 2007, a large network of now 244 certified CPU`s has been established in Germany, Austria and Switzerland (www.dgk.org) [5]. This new health care structure has been demonstrated to improve outcome compared to regular emergency department care for patients who reach the hospital with an ACS excluding patients with STEMI [6], to reduce the length of hospital stay [7] and to improve patients' satisfaction [8]. Recently, the CPU guidelines of the German Cardiac Society have been updated [9]. As in the ESC guidelines the recommendation is that STEMI-patients should not be admitted to the CPU but rather immediately transferred to the heart catheterization laboratory [9].

Despite these recommendations, a significant number of patients with STEMI are still admitted to in-hospital CPUs. Several reasons may account for this deviation, including missed diagnosis, self-referrals [10], absence of a pre-hospital ECG [11], an ECG without clear ST-elevation despite complete vessel occlusion (e.g. proximal circumflex occlusion) [12,13],logistical reasons within the chain of care or non-adherence to STEMI guidelines [1].

Since the deviation of STEMI patients to chest pain units costs time and may adversely impact prognosis, it is important to understand the circumstances of deviations, to characterize the deviated STEMI patients and to quantify the impact on critical time intervals. In addition, a detailed analysis may also help to take the necessary measures in order to avoid deviations in the future.

2. Methods: see online supplement

2.1. Results

2.1.1. Patient characteristics

A total of 1679 CPU-STEMI patients were available for analysis, representing 8.5% of the 19,666 patients documented in the CPU registry for the analyzed time period. The overarching diagnosis in the 19,666 patients enrolled in the German CPU registry was NSTEMI followed by unstable angina (Online supplement Table 1).

Patient characteristics were grouped by their way of admittance and are summarized in Table 1. The majority of patients were admitted via EMS (55.9%), the remaining patients admitted from other hospitals (16.1%), by the GP (15.2%) or presented to the CPU as self-referrals (12.7%). The mean age was 63.1 ± 13.7 years. There were about ¾

Table 1
Patient characteristics admitted to the hospital by the emergency medical system (EMS), other hospitals, general practitioners (GP) or self-referrals.

	Total	EMS	Transfer from other hospitals	GP	Self referrals	*p*-Value
Number of patients	1679 (100%)	938 (55.9%)	271 (16.1%)	256 (15.2%)	214 (12.7%)	
Demographic and clinical characteristics						
Age (years), median	62.9	63.2	62.5	64.9	59.9	<0.003
Women	24.7%	24.4%	24.4%	26.2%	24.3%	0.95
History of CVD	29.8%	30.4%	27.5%	23.1%	38.0%	<0.004
Prior MI	11.8%	11.3%	14.9%	8.2%	14.1%	0.077
Prior bypass surgery	3.8%	3.1%	5.2%	2.7%	6.6%	0.051
Prior PCI	13.5%	14.9%	10.4%	8.6%	17.4%	<0.009
Diabetes mellitus	19.8%	18.7%	21.2%	23.0%	18.7%	0.41
Chronic kidney disease	6.0%	6.4%	6.3%	5.9%	3.7%	0.52
Arterial hypertension	66.3%	66.5%	65.1%	66.8%	66.4%	0.97
Hyperlipidemia	46.7%	48.1%	37.5%	51.2%	47.2%	<0.008
Smoker	45.1%	45.2%	48.3%	38.3%	49.1%	0.063
Positive family history	21.1%	20.9%	18.6%	21.9%	24.3%	0.49
Symptoms at admission						
Chest pain	96.1%	96.3%	95.6%	94.9%	97.7%	0.45
Dyspnea	13.4%	13.2%	12.6%	14.5%	14.0%	0.92
Killip Class ≥ II	6.7%	7.5%	6.3%	5.5%	5.2%	0.48
Pre-hospital ECG						
ECG-documented	44.8%	48.4%	60.5%	48.4%	4.7%	<0.001
ST-segment elevation	87.4%	89.8%	84.8%	84.7%	50%	
ST-segment elevation + LBBB	90.2%	91.6%	89.6%	88.7%	50%	<0.001
In hospital (CPU) ECG						
ECG documented <10 min	64.5	62.4	62.7	65.7	74.3	0.055
ST-segment elevation	74.0%	76.2%	55.2%	79.8%	80.3%	<0.001
ST-segment elevation + LBBB	77.6%	78.4	61.4	87.0	82.6	<0.001
Invasive diagnostics						
No CAD	0.5%	0.4%	1.1%	0.0%	0.0%	0.92
1-Vessel	38.5%	38.7%	37.3%	39.6%	38.3%	
2-Vessel	27.6%	25.7%	32.2%	26.4%	29.9%	
3-Vessel	33.4%	35.2%	29.4%	34.0%	31.8%	
GRACE score[a]/death in CPU						
GRACE low risk[b]	46.9%	46.8%	49.2%	34.7%	59.2%	
GRACE intermed[c]	33.4%	32.7%	30.9%	42.2%	29.1%	
GRACE high risk[d]	19.6%	20.4%	19.9%	34.7%	11.7%	
Death in CPU	1.5%	1.7%	1.9%	0.8%	0.9%	0.60

CPU: chest pain unit; FMC: first medical contact; MI; myocardial infarction, PCI; percutaneous coronary intervention; LBBB: left bundle brunch block; CAD: coronary artery disease.
[a] GRACE score for in hospital mortality.
[b] Low risk: ≤125 points.
[c] Intermediate risk: 126–154 points.
[d] High risk: ≥155 points.