

The Swietokrzyskie System for the Optimal Management of Acute Myocardial Infarction

Janusz Sielski^{1,2}, Marianna Janion^{1,2}, Agnieszka Janion-Sadowska¹, Monika Cugowska¹, Marcin Sadowski¹, Wojciech Gutkowski¹, Marian Sierant³, Grzegorz Dzik⁴, Zdzisława Staskiewicz-Rozek⁵, Marta Solnica⁶, Maciej Maliszewski⁷

¹Department of Cardiology, Swietokrzyskie Center of Cardiology, Kielce, Poland

²Faculty of Health Studies, University of Humanities and Science, Kielce, Poland

³Department of Cardiology, Hospital Konskie, Konskie, Poland

⁴Department of Cardiology, Polish American Cardiac Clinics, Starachowice, Poland

⁵Department of Cardiology, Hospital Sandomierz, Sandomierz, Poland

⁶Center of Ambulans Services, Kielce, Poland

⁷Department of Cardiology, Center of Invasive Cardiology, Ostrowiec Swietokrzyski, Poland

Abstract

We present activities undertaken in Poland's Swietokrzyskie province to shorten the time to recanalization of infarct-related arteries in patients with acute myocardial infarction. All emergency medical institutions have been obliged by the Governor of Swietokrzyskie to implement the System for Optimal Management of Acute Myocardial Infarction. The effects of this action are discussed, and similar systems in Europe are reviewed. (Cardiol J 2011; 18, 2: 134–139)

Key words: ST-elevation myocardial infarction, invasive treatment strategies, optimization of intervention time

Introduction

Acute coronary syndromes (ACS) are a heterogeneous group of conditions with a sudden interruption of the blood flow in infarct-related arteries. According to the guidelines of the European Society of Cardiology (ESC), based on an ECG performed on first medical contact (FMC) with the patient, ACS are divided into ST segment elevation ACS (STACS) and non-ST segment elevation ACS (NSTACS) [1, 2]. Myocardial infarction (MI), STEMI as well as NSTEMI, may develop in both ACS categories and refers to irreversible cell injury within the myocardium supplied by the coronary artery in which blood flow is impaired, usually due to sudden and total occlusion. It is a life-threatening condition which, if left untreated, accounts for

about 40% of deaths in any one year and disability among survivors. Until now, there has been no precise data on the incidence of ACS in Poland. It is estimated that there are 80,000–100,000 patients with ACS annually, of whom 30% have STEMI [3, 4]. In Swietokrzyskie province, with a population of 1.25 million people, there are about 5,000 cases of ACS annually, including 1,500 with STEMI [5].

The time from symptoms onset to the recanalization of the infarct-related artery has a tremendous impact on the progression of myocardial necrosis and consequently on in-hospital and late mortality. Each additional 30 minute delay increases annual mortality by about 7.5% [6].

An essential step in the management of STEMI, according to the pathophysiology, research and worldwide scientific guidelines, is achieving

Address for correspondence: Janusz Sielski, MD, PhD, Department of Cardiology, Swietokrzyskie Center of Cardiology, Grunwaldzka 45, 25–736 Kielce, Poland, tel: +48 41 367 14 93, e-mail: jsielski7@interia.pl

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rapid and complete reperfusion. Reperfusion therapy has been used since the 1980s, initially as intravenous fibrinolytic therapy, and now as primary percutaneous coronary intervention (pPCI). This technique was first applied in 1983 [7]. Now, after 30 years of refinement and the availability of a new generation of balloon catheters, guidewires and stents, novel diagnostic imaging and pharmacotherapy, it has become a routine and effective strategy. It can be applied in most patients with STEMI, it permits achievement of complete reperfusion in 70–90% of patients, it reduces intracranial bleeding, and, in patients with cardiogenic shock, it is the method of choice. Primary PCI lowers significantly mortality, nonfatal reinfarction and disabling stroke rates.

According to the current ESC guidelines, pPCI should be performed within 120 min after FMC. In patients with extensive myocardial infarction (MI), and those referred early (< 120 min from pain onset), this time should be lessened by 30 min. Only if pPCI is not feasible within 120 min is fibrinolytic therapy recommended [1].

Current evidence shows that the benefit of early recanalization of the infarct-related artery is unquestionable. Time from pain onset to myocardial reperfusion determines prognosis (survival in the acute phase, disability grade and ability to work). In this clinical setting, each minute is important. Primary PCI performed as early as possible after the onset of pain is the best strategy to treat STEMI.

Treatment of acute coronary syndromes in Swietokrzyskie province

The history of Swietokrzyskie cardiology and the treatment of MI dates back to 1977 when the first ward of cardiology was established in the Regional Hospital of Kielce. Reperfusion therapy (fibrinolysis) in patients with STEMI was first used in 1990. In 2000, the Swietokrzyskie Centre of Cardiology (SCC) was opened, and first coronary angiography and angioplasty were performed in the new cath lab opened in 2001. In 2002, a 24-hour on-call duty schedule was introduced for the management of patients with STEMI in the region. However, the maximum distance of 90–110 km to the SCC, and consequently prolonged transport time, prevented some patients from receiving invasive therapy within the recommended timeframe. Nevertheless, in 2005 and 2006 a 30-day mortality of 5.4% was noticed in STEMI patients who underwent pPCI, which is comparable to the results obtained in the best centers in the world [8]. Assum-

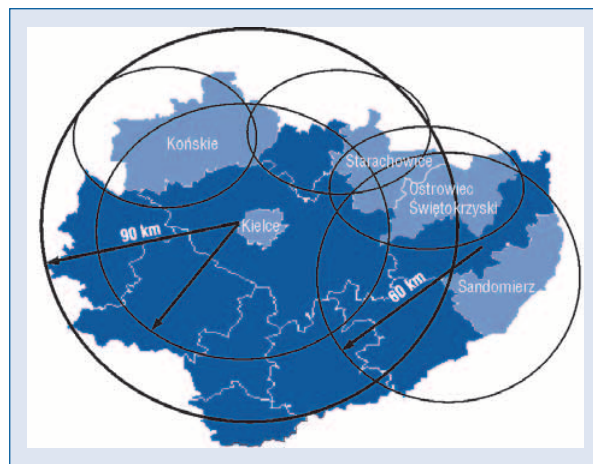


Figure 1. Cath labs in Swietokrzyskie province.

ing that pPCI has a tremendous effect on mortality, and that this method was to be available within the recommended timeframe for the majority of inhabitants of our region, we considered the wider implementation of pPCI would further reduce mortality and improve the quality of care. As a result, new cath labs were opened to provide pPCI 24 hours a day in Sandomierz in 2006, in Ostrowiec Swietokrzyski, Koneskie and Starachowice in 2008 (Fig. 1).

According to the 2009 ESC project, it was recommended to perform pPCI in at least 70% of all STEMI patients and to achieve pPCI rates of at least 600 per 1 million inhabitants per year [9]. In Swietokrzyskie province, these recommendations regarding changes in rates were executed. In 2009, pPCI was performed in 77.4% of STEMI patients (880 patients per 1 million inhabitants) [5], which is a better result than in most European countries. However, the procedure was done outside the recommended timeframe in as many as 75% of STEMI patients.

In Swietokrzyskie province, reports from the heads of cardiac wards show that the longest delays occur if STEMI patients are referred to a Hospital Emergency Department (HED) and/or intensive cardiac care unit (ICCU) without PCI capabilities and only then transferred to a PCI-capable hospital. This transportation pattern significantly delays time to intervention and more radical measures should be undertaken to allow for transport of patients directly to the nearest cath lab.

Under the National Emergency Medical Care Act in Poland, patients with life-threatening medical emergencies must be transported without delay to the nearest healthcare institution providing specific treatment. In case of patients with MI, it

Table 1. Activities undertaken to reduce delay in seeking treatment by patients with myocardial infarction.

| To reduce | Activities |
|--|--|
| Pain-to-diagnosis time | Educational programs for patients and physicians in workplaces, schools, and via press, radio and TV. Symptom knowledge determines intent to call an ambulance. |
| Pre-hospital transport time — on-scene-to-arrival at hospital | Appropriate organization and co-operation of emergency service providers to assure immediate ambulance dispatch if myocardial infarction is suspected and the swiftest transit to the invasive cardiology center. |
| In-hospital transport time — door-to-balloon time | Direct referral to the cardiac emergency department or cath lab, bypassing the Hospital Emergency Department and/or intensive cardiac care unit. Patient monitoring from door to balloon to maintain staff motivation and organizational efficacy. Mean time should not exceed 30 min! |

should be the nearest invasive cardiology center with a 24-hour duty schedule. A medical director or emergency medical dispatcher (EMD) or physician medical co-ordinator decides where the patient should be transferred. If the patient is going to be sent to a hospital outside the EMD coverage area, transport to the nearest invasive cardiology center is co-ordinated by a physician medical co-ordinator. In cases of referral to the HED (via the ambulance service or self-referral) and the diagnosis of MI, the responsibility for rapid transport rests with the referring hospital.

As it is evident that the longer the delay in STEMI treatment, the greater the rates of mortality, disability, therapy and other social costs, then more radical measures should be undertaken to change the situation [9–17]. Analysis of the data from the Polish Registry of Acute Coronary Syndromes (PL-ACS) [5] shows that in Swietokrzyskie province in 2009, onset-to-balloon time exceeded 285 min and PCI centers door-to-balloon time was 73 min.

In these circumstances, it is advisable to initiate steps to reduce delay and to guarantee the recommended timeframe, which should markedly improve therapeutic outcome, reduce mortality rate and disability grade in affected patients.

The Swietokrzyskie System for Optimal Management of Acute Myocardial Infarction

In order to reduce delay in seeking treatment by patients with MI, co-ordinated activities had been undertaken among potential patients, physicians and emergency staff, ambulance service dispatchers, hospital directors, doctors on the HEDs and ICCUs and cath lab personnel (Table 1). The type of activity was inspired by the initiatives undertaken

in the framework of the Malopolska Registry of Acute Coronary Syndromes as described elsewhere [13, 14, 16, 17]. In order to implement these activities, as proposed by regional consultants in cardiology and emergency medicine, Directors of the Swietokrzyskie Center of Emergency Medicine, Directors of the Ambulance Service and the National Health Fund, the Governor of Swietokrzyskie province passed a recommendation for establishing “The Swietokrzyskie System for Optimal Treatment of Acute Myocardial Infarction” [18] with the objectives of:

1. Assure co-operation between ambulance service and PCI-capable hospitals with a 24-hour duty schedule, bypassing Hospital Emergency Departments, to reduce time from pain onset to reperfusion in patients with MI.
2. Use the optimal reperfusion strategy on cardiological wards and in cath labs in compliance with the guidelines.
3. Implement successful quality monitoring programmes in order to maintain permanent supervision over the organization of invasive therapy. Analysis of similar solutions introduced in numerous cardiological centers across Europe (Table 2) shows that the monitoring of delay helped to identify the problem and the ensuing activities resulted in radical delay reduction, and consequently increased the number of golden-hour patients, significantly reduced in-hospital mortality and improved markedly long-term prognosis in patients with MI [9–16].

Management strategies in STEMI and NSTEMI

Different strategies are recommended depending on the initial diagnosis (STEACS or NSACS) based on history, physical examination and ECG

Table 2. Current experience — optimal care systems (data for 2003–2007) [7–9] and 2009 data for Swietokrzyskie province [3]

| Registry | Pain-to-balloon time [min] | Transport time [min] | Cath lab door-to-balloon time [min] |
|----------------------------------|----------------------------|----------------------|-------------------------------------|
| Prague-2 (the Czech Republic) | 280 (90–470) | 48 (28–68) | 26 (15–37) |
| Danami-2 (Denmark)* | 224 (171–317) | 32 (20–45) | 26 (20–38) |
| Vienna Registry (Austria) | 258 (90–426) | 20 | 31 (8–54) |
| RIKS-HIA (Sweden) | 210 (135–334) | 39 (22–65) | 30 (12–70) |
| PL-ACS (Swietokrzyskie province) | 285 (150–590) | 52 (37–79) | 73 (50–166) |

*Median and quartile range, all other values are mean ± SD

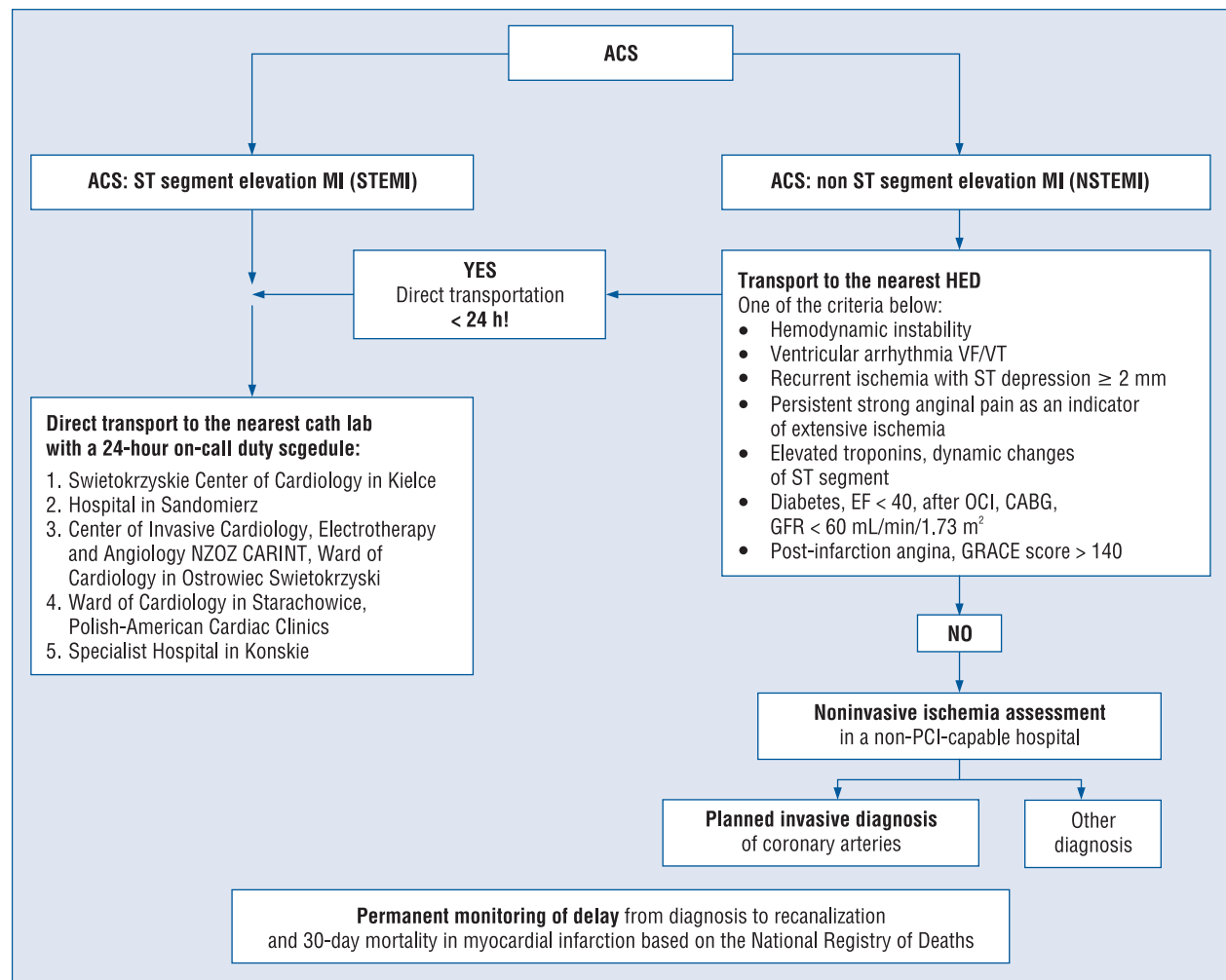


Figure 2. Strategy outline for acute coronary syndrome (ACS) patients according to the “Swietokrzyskie System for Optimal Management of Myocardial Infarction” (modified from [10]).

recording (Fig. 2) [1, 2, 13]. In all STEACS cases, it is recommended to transport the patient immediately and directly to the nearest PCI-capable hospital with a 24 hours duty schedule in an ambulance equipped with 12-lead ECG recorder and transmis-

sion system for interpretation by experienced staff in a cath lab. All other ways of transport are discouraged. If pPCI is not available within the recommended timeframe, pharmacoinvasive therapy should be considered. It concerns patients in whom

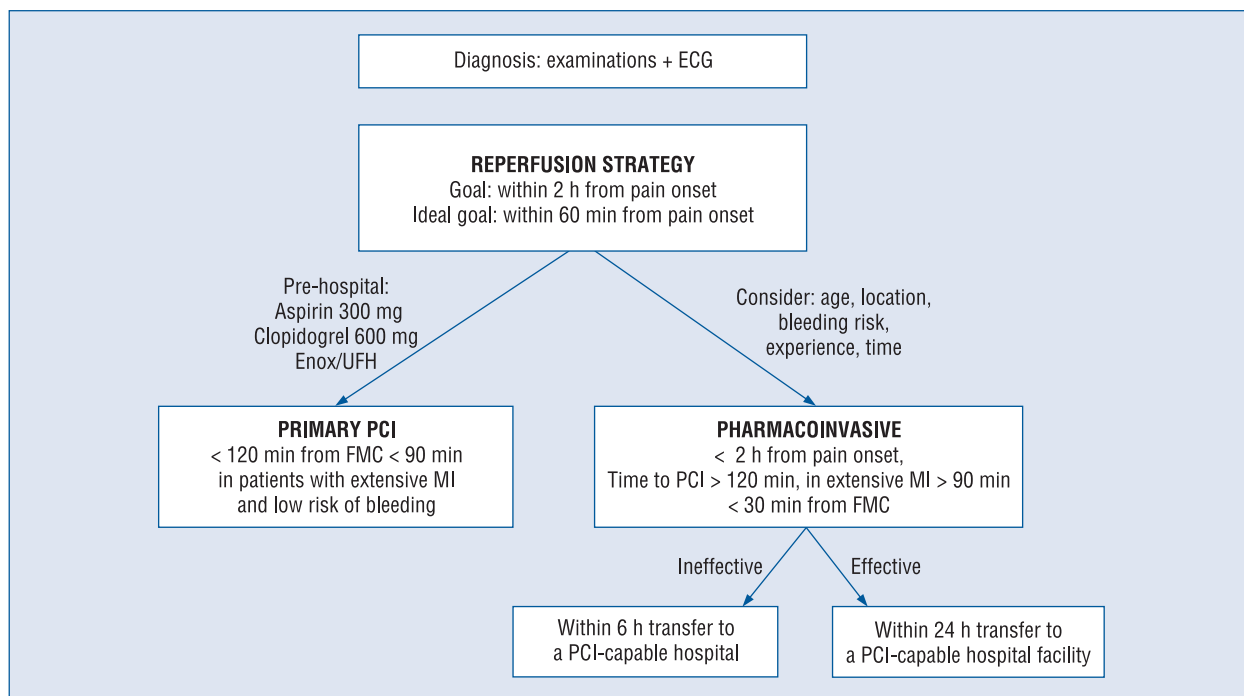


Figure 3. Optimal STEMI treatment strategy.

PCI is not feasible < 2 h from pain onset and < 90 min in case of patients with high risk MI. A pharmacoinvasive strategy consists of pre-hospital fibrinolysis and then transfer to a PCI center for coronary angiography within the first 24 h after effective fibrinolysis and within six hours after ineffective thrombolytic therapy (Fig. 3).

Patients with NSTEMI should be referred to the nearest Hospital Emergency Department or admissions office of the community hospital for initial risk assessment. High-risk patients should be transferred directly to the nearest invasive cardiology center within 72 h (ideally < 24 h). Only low-risk patients should be admitted to cardiac and internal medicine wards in hospitals without 24 h duty schedules to decide about further management, including invasive diagnostic procedures to identify coronary artery disease.

To assure the successful implementation of the above described system requires the involvement of both governmental bodies and healthcare workers. So, the following changes in transport system and patient management have been made:

1. Optimization of transportation as required, with particular emphasis on direct transport of patients with definite STEMI to an interventional cardiology center, bypassing HEDs and/or ICCUs.

2. Implementation of ECG teletransmission (from an ambulance and emergency departments in smaller hospitals to the nearest interventional cardiology center) in cases when the diagnosis of STEMI based on the ECG recording is equivocal and requires destination decision.
3. Continuous education for healthcare workers (rescuers, ambulance, admissions and emergency department physicians) on the management of STEMI.
4. Permanent monitoring of the whole system in order to eliminate weak points and improve the quality of care for STEMI patients.

Conclusions

Introducing a pPCI service in Swietokrzyskie province resulted in a decrease of mortality in invasively treated STEMI patients of 5.4%. A further improvement is expected after optimization of transportation for STEMI patients and implementation of “The Swietokrzyskie System for Optimal Management of Acute Myocardial Infarction”. The practice of direct ambulance transfer to cath labs will reduce delay from diagnosis to intervention, and consequently improve treatment outcomes. Results of the programme will be evaluated via permanent monitoring of delay from diagnosis to intervention and 30-day mortality (quality monitoring in invasive treatment of MI).

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