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\*Artur Borowicz<sup>1</sup>, Klaudiusz Nadolny<sup>1,2</sup>, Michal Kucap<sup>1,3</sup>, Mariusz Gasior<sup>4</sup>, Bartosz Hudzik<sup>4,5</sup>

## The role and operation of emergency medical teams in patients with ST-segment elevation myocardial infarction

### Rola i działanie zespołów ratownictwa medycznego u pacjentów z zawałem serca z uniesieniem odcinka ST

<sup>1</sup>Voivodeship Rescue Service in Katowice, Poland<sup>2</sup>Department of Emergency Medicine and Disasters, Medical University of Białystok, Voivodeship Rescue Service in Katowice, Poland<sup>3</sup>College of Strategic Planning in Dabrowa Gornicza, Poland<sup>4</sup>3<sup>rd</sup> Department of Cardiology, School of Medicine with The Division of Dentistry in Zabrze, Medical University of Silesia, Katowice, Poland<sup>5</sup>Department of Nutrition-Related Disease Prevention, School of Public Health in Bytom, Medical University of Silesia in Katowice, Poland

#### Keywords

medical rescue team, ST-segment elevation myocardial infarction, percutaneous coronary intervention

#### Słowa kluczowe

zespół ratownictwa medycznego, zawał mięśnia sercowego z uniesieniem odcinka ST, przeszskórna interwencja wieńcowa

#### Conflict of interest

#### Konflikt interesów

None

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#### Address/adres:

\*Artur Borowicz  
Wojewódzkie Pogotowie Ratunkowe  
w Katowicach  
ul. Powstańców 52, 40-024 Katowice  
tel.: +48 695 906 500  
doktorbo@vp.pl

#### Summary

Cardiovascular diseases are the main cause of global mortality and constitute 30% of all deaths annually. The leading cardiovascular diseases are coronary disease and myocardial infarction.

The incidence of myocardial infarction with ST-segment elevation (STEMI) in Europe varies between 44 and 155/100,000 individuals per year. The annual number of STEMI cases in Poland amounts to about 80,000 individuals. Unfortunately, the values of patient-related delay in contacting medical services are significantly high and result from numerous factors. Social campaigns may lead to a minimization of this delay. The system of medical rescue plays an important role in the treatment of STEMI patients and in the decrease of mortality. Starting with a medical dispatcher, who is the first member of the medical personnel to have contact with the witness of the incident or the patient, and continuing with a medical rescue team. STEMI treatment should already be initiated in an ambulance. The basic procedure in prehospital STEMI patients is the system of teletransmission and teleconsultation, which ensure a prompt diagnosis and a direct transport to the center with the earliest reperfusion therapy available.

Minimizing the time from the occurrence of chest pain to coronary artery reperfusion leads to a decreased mortality caused by ST-segment elevation myocardial infarction.

#### Streszczenie

Choroby sercowo-naczyniowe są główną przyczyną umieralności na świecie i stanowią 17,5 miliona zgonów rocznie lub 31% wszystkich zgonów na świecie rocznie. Wśród nich na pierwsze miejsce wysuwają się choroba wieńcowa oraz zawał mięśnia sercowego.

Częstość występowania zawału serca z uniesieniem odcinka ST (STEMI) w Europie waha się od 44 do 155/100 000 osób rocznie. W Polsce szacuje się, że STEMI występuje u około 80 000 osób rocznie. Niestety opóźnienia pacjenta w zakresie kontaktu ze służbą zdrowia są bardzo duże. Wynikają one z wielu czynników. Kampanie społeczne mogą przyczynić się do skrócenia tego czasu. Istotną rolę w leczeniu pacjentów ze STEMI oraz zmniejszeniu śmiertelności odgrywa system ratownictwa medycznego – począwszy od dyspozytora medycznego, który ma kontakt jako pierwsza osoba medyczna ze świadkiem zdarzenia albo z samym pacjentem, poprzez zespół ratownictwa medycznego. Już na etapie ambulansu zespół medyczny powinien rozpocząć leczenie. Podstawowym elementem jest system teletransmisji i telekonsultacji, który umożliwia szybkie i skuteczne leczenie reperfuzyjne pacjentów z ostrym zespołem wieńcowym.

Skrócenie czasu od bólu w klatce piersiowej do udrożnienia zamkniętego naczynia wieńcowego powoduje niższy wskaźnik śmiertelności z powodu zawału mięśnia sercowego z uniesieniem odcinka ST.

**INTRODUCTION**

Cardiovascular diseases are the main cause of global mortality and constitute 17.5 mln deaths annually or 30% of all deaths worldwide per year (1). The leading cardiovascular diseases are coronary disease and myocardial infarction. Acute coronary syndromes are diagnosed in 1.5 mln patients worldwide (2), and in 140,000 patients in Poland (3). Over the past three decades in Europe, there has been a tendency towards a decreasing coronary disease-related mortality. However, over 4 mln European patients die due to cardiovascular diseases every year, which constitutes 45% of the total number of deaths in Europe (4). Coronary disease is the cause of about 20% of all deaths in Europe. The coronary disease-related mortality rate in Poland amounts to 191 deaths in 100,000 inhabitants. It is worth noticing that the rate has decreased by 39% throughout the past decade. Nevertheless, this rate remains higher than the European rate amounting to 132 deaths in 100,000 inhabitants (5). The incidence of ST-segment elevation myocardial infarction (STEMI) in Europe varies between 44 and 155/100,000 individuals annually. It has been estimated that in Poland, STEMI is diagnosed in 80,000 individuals per year (6, 7). STEMI-related mortality depends on numerous factors such as age, Killip class assigned to patients at admission, delayed treatment, the emergency medical system (EMS)-based STEMI networks, the selected therapy, diabetes, renal failure, and multi-vessel coronary artery disease. In spite of the implementation of new drugs in the antithrombotic therapy and the improvement of percutaneous coronary intervention (PCI) techniques,

the in-hospital STEMI-related mortality varies between 4 and 12%, and amounts to 10% in the next 12 months after myocardial infarction (8, 9).

**REVIEW**

STEMI-related procedures (including both diagnosis and treatment) is initiated at the moment of first medical contact, FMC (10). European experts suggest that local strategies of reperfusion therapy should be created to maximize the effectiveness of treatment (5). Delays in the treatment of STEMI are the most easily audited indicators of the quality of care. There are two types of delays related to the treatment of STEMI (fig. 1):

- patient-related delays,
- system delays.

In order to minimize patient-related delays, it is recommended to raise social awareness as far as the ability to identify myocardial infarction symptoms and reporting these symptoms to rescue services are concerned. Regarding the aspects of system delays, they all indicate the quality level of medical care (11).

The system of Emergency Medical Services (EMS) is crucial in dealing with STEMI patients, and is not only responsible for transport but also contributes to a prompt diagnosis of myocardial infarction, an appropriate patient triage, and implementation of preliminary treatment (12). Emergency medical units are divided into:

- specialized emergency medical teams with a minimum of three individuals qualified to perform emergency medical procedures, including a doctor and a nurse or a paramedic of the EMS system,

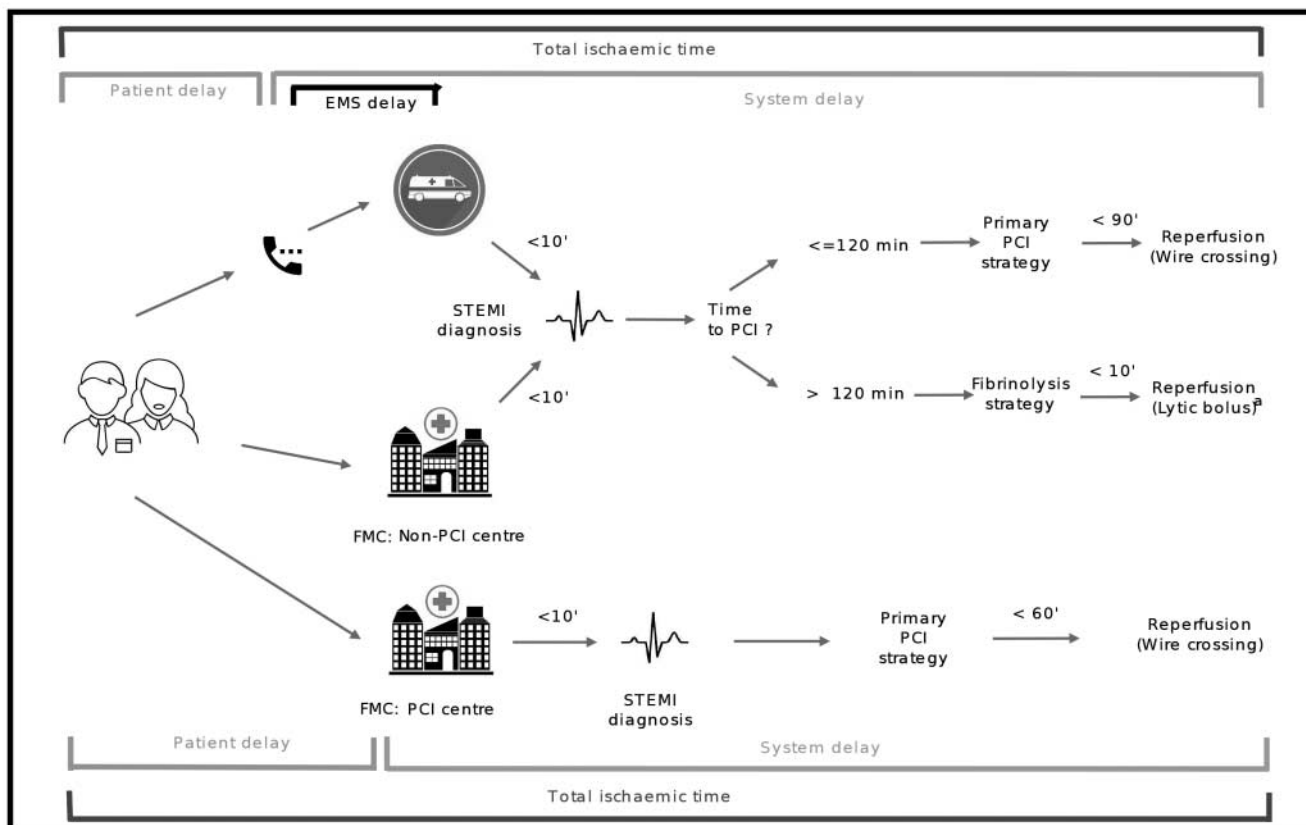


Fig. 1. Delays related to the treatment of STEMI

– basic emergency medical teams with at least two individuals qualified to perform emergency medical procedures, including a nurse or a paramedic of the EMS system – Article 36 (1) Law on State Emergency Medical Services (13).

Percutaneous coronary intervention (PCI) is the best way of STEMI treatment and leads to a decreased mortality and prevalence when contrasted with conservative therapy and thrombolytic treatment. The longer the time from the first medical contact (FMC) to the reperfusion of the artery responsible for myocardial infarction, the lower the implied outcome (14). There was a clear relationship between the delay in primary PCI and mortality in an annual observation. Every 30 minutes of delay in an invasive treatment was related to an increase of the relative annual ratio of mortality by 7.5%. The above-mentioned results have been considered in the recommendations of the European Society of Cardiology that focus on the time between the moment the patient reports to the doctor and the initiation of reperfusion therapy (15, 16).

The definitions of the particular delay components related to both the prehospital and the in-hospital treatment have been clearly stated by the experts of the European Society of Cardiology (ESC) and the Acute Cardiovascular Care Association (ACCA) (tab. 1).

The implementation of the recommendations in everyday clinical practice faces numerous logistic challenges leading to a significant exceeding of the recommended time limits. According to American studies, only 4.2% of patients meet the 90-minute criterion (and 15% of patients meet the 120-minute criterion). An analysis based on the European register indicates that in the case of patients transferred from a non-PCI center or directly from the place of event to a catheterization laboratory, the 90-minute criterion expectations were met in 35% of cases, and the 120-minute criterion – in 60% of cases (17, 18). Considering the facts that the current recommendations regarding acute coronary syndrome (ACS) procedures are in favor of an early invasive strategy, and that the network of interventional cardiology centers available 24/7 for patients with myocardial infarction is of enough size, the following strategy should be adopted in the case of STEMI diagnosis (19):

It is recommended that STEMI patients are transferred to an interventional cardiology center available 24/7. EMTs should bypass other centers, i.e. hospital emergency departments, admission departments, and hospitals with no 24/7 infarction-related assistance (11, 20). To support this process, all ambulances should be equipped with an ECG teletransmission system to consult the ECG results with the nearest interventional cardiology center. It is especially important for basic ambulances operated exclusively by paramedics (21). In cases when patients with the acute coronary syndrome (ACS) and ST-segment elevation report to a hospital emergency department, an admission department, or a hospital with no 24/7 infarction-related assistance, the patient needs to be immediately transferred to the nearest interventional cardiology center.

Based on the Law on State Emergency Medical Services, the medical care system and emergency medical teams (EMT) are obliged to immediately transfer individuals in life-threatening conditions to the most easily accessible entity (as far as time of access is concerned), i.e. to a hospital emergency department, a healthcare center capable of dealing with the specific disease, or a department specialized in services required in emergency medicine. The decision regarding transfer destination is made by an EMT leader, a medical dispatcher or an emergency medical coordinating doctor. In cases when the destination is outside the region monitored by the particular dispatch entity, the transfer to the nearest interventional cardiology center is coordinated by the emergency medical coordinating doctor. However, in the case when a STEMI patient stays at an admission department or at a hospital emergency department with no catheterization lab (including patients transferred there by EMTs or by themselves), it is the hospital reporting the patient to interventional therapy that is responsible for the organization and the time of the transfer. This transfer can be performed by a hospital transport unit or according to external contracts (13).

### Acute coronary syndrome therapy

In order to efficiently inhibit platelet aggregation, dual antiplatelet therapy (DAPT) is required, DAPT involving

**Tab. 1.** Delays in dealing with STEMI patients

Type of delay	Definition	Optimal time/factors with an impact on the delay
Patient-related	Time from the onset of symptoms to the time of EMS phone alert	-/educational campaigns
Field delay, EMS delay	Time from the EMS phone alert to FMC	< 20 min/topographical and logistic factors
Diagnosis-related	Time from FMC to ECG	< 10 min/ECG interpretation skills presented by the EMT, ECG teletransmission
Time to reperfusion	Time from STEMI diagnosis to wire crossing of the infarct-related artery	patients in prehospital conditions < 90 min patients directly admitted to a hospital with a catheterization laboratory < 60 min patients with a myocardial infarction who need to be transferred to a hospital with a catheterization laboratory < 120 min
System delay	From the time of EMS phone alert (or FMC) to reperfusion	-/the efficiency of regional prehospital and hospital care treatment in STEMI patients

ECG – electrocardiogram; FMC – first medical contact; STEMI – ST-segment elevation myocardial infarction; EMT – emergency medical team

the application of both acetylsalicylic acid (ASA) and a P2Y12 inhibitor in patients with STEMI (22-24). According to the current recommendations, the oral dose of plain ASA should be 150-300 mg in all ACS patients with no contraindications and no previous chronic ASA administration (16).

The following oral P2Y12 inhibitors are currently applied in Poland: clopidogrel, prasugrel, and ticagrelor. The new P2Y12 inhibitors, prasugrel and ticagrelor, are preferred as they have a more rapid onset of action, are more potent, and have a more homogenous antiaggregation effect than clopidogrel. These features result in better research outcomes in the administration of prasugrel and ticagrelor than in the outcomes presented by clopidogrel (25, 26). When initiating a P2Y12 inhibitor therapy, any contraindications related to this group of inhibitor should be considered. In patients with an earlier administered loading dose of clopidogrel, antiplatelet therapy can be modified and ticagrelor treatment can be initiated (25, 26), which is not recommended in the case of prasugrel. In the case of STEMI patients, a P2Y12 inhibitor should be administered as soon as possible, i.e. at the moment of the first medical contact, class of recommendation: I, level of evidence: B (27). Ticagrelor (180 mg loading dose administered when there are no contraindications, and then 90 mg maintenance dose twice daily) and prasugrel (60 mg loading dose administered when there are no contraindications, and 10 mg maintenance dose once daily) are the preferred P2Y12 inhibitors. Both drugs mentioned above applied in STEMI patients are included in the same class of recommendation: I, level of evidence: B (22, 23).

According to the Regulation of the Minister of Health of 20 April 2016, paramedics are allowed to independently administer clopidogrel and ticagrelor (after an ECG teletransmission and consultation with an ECG

verifying doctor), but they are not allowed to administer prasugrel (28). Apart from DAPT, STEMI patients require an antithrombotic therapy in their perioperative period. Based on the above-mentioned regulation of the Minister of Health, the only anticoagulant available for paramedics to apply independently is unfractionated heparin (70-100 measurement unit/kg *i.v.*) (28).

The most frequently used analgesics administered in ACS patients (especially in patients with myocardial infarction) is morphine, which additionally induces calm and euphoric conditions in patients. However, morphine is related to a relatively frequent occurrence of adverse effects.

The available studies on potential interactions clearly identified a negative impact of morphine on the oral P2Y12 inhibitors absorption and effect. This has no clear clinical outcome but there is some research available that indicates the potential negative impact of morphine on mortality and infarct size (29-32).

## CONCLUSIONS

Cardio-vascular diseases are a serious medical, social and economic issue. Unfortunately, the values of patient-related delay in contacting medical services are significantly high and result from numerous factors. Social campaigns may decrease this delay. The system of medical rescue plays an important role in the treatment of STEMI patients and in the decrease of mortality: from a medical dispatcher, who is the first member of the medical personnel to have contact with the witness of the incident or the patient, through a medical rescue team, to an interventional cardiologist. The treatment should already be initiated in an ambulance. The basic procedure in prehospital STEMI patients is the system of teletransmission and teleconsultation, which ensure a prompt and effective reperfusion therapy in patients with myocardial infarction.

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