

# THE PROCEEDINGS OF MEDICAL EMERGENCY TEAMS WITH PATIENTS WITH ACUTE MYOCARDIAL INFARCTION WITH AN ELEVATION OF ST-SEGMENT IN THE GORLICE COUNTY

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## ABSTRACT

**INTRODUCTION:** Ischaemic heart disease and myocardial infarction are the main cause of morbidity and mortality in western civilizations. In the broad definition of ischaemic heart disease is a disease entity which is STEMI. It is a life-threatening condition that can lead to cardiac arrest in a short time. The development of knowledge and treatment systems has contributed to a significant decrease in-hospital mortality as a result of STEMI, however, the total mortality because of this disease has practically not decreased, because about 2/3 of deaths occur in the pre-hospital period before the patient receives reperfusion therapy. Therefore, it is so important to regularly analyse the rescue procedure and modernize solutions aimed at improving the survivability of these people. The aim of the study is to evaluate the proceeding of emergency medical teams in patients with acute myocardial infarction with ST elevation on the ECG.

**MATERIAL AND METHODS:** The Rescue Orders Cards and Medical Rescue Operations Cards of emergency medical teams operating in the Gorlice county in the period from 01.01.2016 to 31.12.2017 were used for the study. There were identified cases in which diagnosis from group I21 according to ICD-10 was made and all other cases in which patients were transported directly to the haemodynamic regardless of the diagnosis made, and in whom in ECG was diagnosed STEMI.

The study was carried out based on the analysis of medical documentation of the Emergency Service in Gorlice. A type of Desk Research analysis was also used to review the available literature and research results of other authors from recent years.

**RESULTS:** Analysis of the research material showed that:

- statutory criteria of reach time to the patient were met in 68.3% of cases,
- 51.14% of patients with STEMI symptoms call on EMS after 2 hours from their occurrence,
- 89.36% of patients with STEMI were transported directly to the haemodynamic,
- the median from diagnosis of STEMI to hand over in cases of transport the patient to the haemodynamic was 65 minutes,
- two-stage antiplatelet treatment is used in 47.87% of cases.

**CONCLUSIONS:** The time of reach EMS to the patient with STEMI is in most cases within the limits of the statutory standard. Most of the patients with STEMI symptoms delay call an ambulance by more than 2 hours. The vast majority of patients with a diagnosis STEMI get directly to the haemodynamic while meeting the assumed time criterion of 100 minutes. The frequency of anticoagulant and antiplatelet drug therapy is not in

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line with current recommendations. In most cases paramedics use ECG tele-transmission.

**KEY WORDS:** ST-segment elevation myocardial infarction, STEMI, Emergency Medical Services, tele-transmission ECG

*Disaster Emerg Med J 2019; 4(2): 42–49*

## INTRODUCTION

Ischaemic heart disease and myocardial infarction are the main cause of morbidity and mortality in the western civilizations [1]. It is estimated that in Poland the number of deaths from cardiovascular diseases, including ischaemic heart disease, already in 2020 will exceed 200,000 [2]. In the broad definition of ischaemic heart disease is a disease entity which is acute myocardial infarction with ST-segment elevation (STEMI). It is a life-threatening condition that can lead to cardiac arrest in a short time. A very important element in the patient's survival chain with the diagnosis of STEMI is the correct behaviour of emergency medical teams at the pre-hospital stage.

Of all calls of emergency medical services (EMS) to chest pain, about 30% of them relate to ischaemic heart disease, and about 5% of acute coronary syndromes (ACS) with-ST segment elevation, when patients require immediate medical intervention [3]. Looking more closely at risk factors that contribute to coronary heart disease, it is assumed that the diagnosis of myocardial infarction in the work of a paramedic will be an increasingly frequent practice, which is why it is so important to know the right conduct, because it is they who often make the first medical contact with the patient and from them depends on the speed and quality of medical assistance.

The development of knowledge and treatment systems has contributed over the years to a drop in mortality due to ischaemic heart disease in Europe, despite the increase in its incidence [1]. There was a significant decrease in in-hospital mortality as a result of STEMI, however, the total mortality from its cause has practically not decreased, since about 2/3 of deaths occur in the pre-hospital period, before the patient receives reperfusion therapy [4]. Therefore, it is so important to further modernize solutions aimed at improving the survivability and quality of life of these people.

The functioning of the emergency medical system is based on the use of various types of guidelines that strictly define unified medical procedures and algorithms. These recommendations indicate the right course of action also with the patient

with STEMI, starting with determining the time for diagnosis of myocardial infarction by the emergency medical team, on-site pharmacological treatment and the choice of reperfusion strategies depending on the time that predictably elapses until the patient transports to the centre performing percutaneous coronary intervention (PCI).

An important aspect is also public awareness of symptoms suggestive of the coronary origin of chest pain and the time after which they call for help. Therefore, as the authors of the European Resuscitation Council (ERC) Guidelines emphasize, the best way to improve survival due to myocardial ischaemia is to shorten the delay from the onset of symptoms to the first medical contact and to undertake appropriate, targeted treatment by paramedics already at pre-hospital stage [4].

Regular analysis of the behaviour of emergency medical teams in patients diagnosed with STEMI allows determining the degree of implementation of the latest recommendations. Such actions provide the basis for further improvement of the level of care offered.

## MATERIAL

The Rescue Orders Cards (KZW) and Medical Rescue Operations Cards (KMCR) of emergency medical teams (EMT) operating in the Gorlice county in the period from 01.01.2016 to 31.12.2017 were used for the study. There were identified cases in which diagnosis from the group I21 according to the International Statistical Classification of Diseases and Health Problems ICD-10 was made and all other cases in which patients were transported or tried to pass them directly to the haemodynamic regardless of the diagnosis made, and in which in ECG was diagnosed STEMI.

## METHODS

The study was conducted based on the analysis of medical documentation of the Emergency Service in Gorlice. The retrospective analysis included: time of onset of disease and notification of EMS, time of reaching the patient and transfer to hospital

treatment, number of tele-transmissions performed, target place of transfer of the patient and applied pharmacotherapy. The obtained information were collected in the Microsoft Excel 2010 database. Using the Statistica ver. 13 an analysis of basic descriptive statistics was performed. The classical threshold  $\alpha = 0.05$  was considered the level of significance.

The work referred to current guidelines and recommendations of European organizations and research results of other authors.

## RESULTS

The study analysed the time from the call of the emergency medical team to reaching the place of the event. Regulations regarding Polish recommendations regarding the time of reach were filled in 68.3% of trips. Detailed data in this respect is presented in Table 1.

In order to determine the time after which patients with STEMI call EMT and at the same time difficulties in the precise formulation of this fact in KMCR, time intervals were used. In 6 cases in KMCR, there was no information on the duration of the complaints. The analysis showed that 28.86% of patients called an ambulance up to 2 hours after the onset of worrying symptoms, 21.59% of the respondents called for help in the time interval of

2–6 hours, and 29.55% after 6 hours from the onset of symptoms. The obtained results indicate that the slightest majority of calls takes place after 2 hours from the occurrence of disturbing symptoms (51.14%),  $p = 0.006$ .

To the haemodynamic were transported directly 89.36% of the whole group. Table 2 shows the place of transport of patients with diagnosed STEMI myocardial infarction based on ECG. The reasons for transporting patients with STEMI to ED / Emergency are shown in Table 3.

In the entire group of 94 patients, 84 of them were transferred directly to the hemodynamic, of which 77 patients had information about the time of transport given in the KMCR. To the time of EMT reach, 10 minutes was added, giving the recommended time for the team to perform and interpret the ECG. 88.31% were transported to the haemodynamic within the assumed time up to 100 minutes, and 11.69% of cases did not meet this criterion. The obtained results indicate that the time of transfer patients to the haemodynamic is in most cases within the limits of the assumed norm, i.e. it is shorter or equal to 100 minutes ( $p < 0.001$ ). The study also showed that the mean time from diagnosis of STEMI to transfer to the haemodynamic was 70.27 minutes (SD = 25.41), the median 65. The minimum elapsed time was 35 minutes and the maximum 150 minutes.

**Table 1. Summary of the time elapsed from the call of EMT to reaching the place of the incident**

	N	M	SD	Me	Q1	Q3	IQR	Min.	Max.
Time from the call to reach the place of the event in minutes	94	10.77	5.22	10.5	6	14	8	1	25
Time from the call to reach the place of the event in minutes outside the city > 10,000 residents	62	12.32	5.42	12	8	15	7	1	25
Time from the call to reach the place of the event in minutes in the city > 10,000 residents	32	7.75	3.12	7	6	8	2	4	16

N — number of cases, M — average, SD — standard deviation, Me — median, Q1 — first quartile, Q3 — third quartile, IQR — interquartile range, Min. — minimum value, Max. — maximum value  
Source: own study

**Table 2. Place of transport of patients with STEMI by EMT in the examined group**

Place of transport	Number of patients	Number of tele-transmissions made	Percentage of transported patients with tele-transmission
Haemodynamic	84	55	65.47
Emergency Room (ER)	1	0	0
Hospital Emergency Department / Emergency	9	6	66.67

Source: own study

Cause	Number of cases
Cardiac arrest during transport to the haemodynamic	2
Proper diagnosis of STEMI (transporting a patient without carrying out tele-transmission on ER to a hospital with a haemodynamic)	1
Erroneous recognition of STEMI by EMT, which after cardiac enzymes determination turned out to be NSTEMI (transporting a patient after tele-transmission to the hospital without a haemodynamic)	3
Erroneous recognition of STEMI by EMT - observation in the direction of ACS negative (transporting the patient once after the tele-transmission and once without her at the Emergency to the hospital without haemodynamic)	2
Patient's lack of consent for transport to the haemodynamic despite STEMI in ECG	1
Refusal to accept a patient to the haemodynamics despite an obvious myocardial infarction	1
Source: own study	

Medicament	N	%
Acetylsalicylic acid (ASA)	71	75.53
Clopidogrel	53	56.38
Ticagrelor	4	4.25
Unfractionated heparin (UFH)	59	62.76
N — number of cases of drug administration, % — percentage of the group; source: own study		

The analysis also looked at the used antiplatelet pharmacotherapy and anticoagulant therapy in STEMI. ASA and clopidogrel or ticagrelor were given in 47.87% of cases, and previously co-injected with unfractionated heparin (UFH) in 43.62% of patients. The use of each drug is shown in Table 4.

The study also determined the frequency with which paramedics use the tele-transmission system. In the examined cases, tele-transmission was performed in 64.89% of cases. The obtained results indicate that in the majority of cases EMT used the tele-transmission system to speed up the treatment ( $p = 0.004$ ).

## DISCUSSION

Emergency medical teams in Poland are one of the main links of prehospital treatment of acute coronary syndromes, in particular, myocardial infarction with ST elevation in the ECG record. However, as A. Budaj emphasizes, despite significant advances in emergency medicine and invasive cardiology, there are still situations in which gaps in the application of guidelines due to their interpretation difficulties, limitations in access to new drugs, and sometimes also lack of appropriate knowledge [1].

From the moment of occurrence of myocardial infarction to reperfusion of occluded vessel, which is

the goal of the treatment in patients with STEMI there are time delays, which often have a significant impact on the effectiveness of treatment. We can distinguish two types of delays associated with STEMI treatment: patient-related delay and system delays. The system includes a medical dispatcher who is the first to have contact with a patient or witness, an emergency medical team whose role is to identify and pre-treat the patient and the invasive cardiology centre as a destination for STEMI patients. One of the most important indicators of the efficiency of the medical emergency system, and thus the quality of medical care is the time of reaching the team to the place of the event. These parameters are regulated by law [5].

Analysing the time of arrival of emergency medical teams from the moment of calling to reaching the place of the event it can be stated that the median for the whole study was 10.5 minutes, and with the division into a city > 10,000 residents and outside of it, respectively: 7 and 12 minutes. These observations are partially confirmed by D. Filip et al. who states that the median time of arrival from the acceptance of the notification by the dispatcher in urban areas and outside the city was 7.5 minutes and 15 minutes respectively, while 9 minutes without this breakdown [6]. Closer results to the results of this research were presented in the studies conducted in Lublin by A. Aftyka et al., where the me-

dian in the urban area was 7 minutes, while outside of it was 13 minutes [7].

The presented results of the analysis indicate that in just over half of the cases of STEMI diagnosis, patients delayed calling for help for more than 2 hours. This may indicate a lack of sufficient knowledge of the public about the symptoms characteristic of acute coronary syndromes and the associated necessity to immediately call an ambulance. In the study was also determined the percentage of people diagnosed with myocardial infarction, who were transported directly to the haemodynamic, because recommendations of the European Cardiac Society (ESC) emphasize that if the diagnosis of STEMI is made at the prehospital stage, the patient should be transported directly to the invasive cardiology department, omitting the emergency department. It was calculated that the omission of the indicated ward is associated with the shortening of the time from the first medical contact to the passage through the guide through the change causing the occlusion of the coronary artery about 20 minutes [8]. The results obtained in this study were confirmed by the information presented by Rzońca et al. who proved that 87.6% of patients diagnosed with acute myocardial infarction in the region of operation of the Emergency Service in Lublin were transported directly to the hospital with the invasive cardiology ward [9].

The reasons for transporting patients to Emergency Room can be divided into two groups, i.e. as a consequence of inadequate emergency procedures (i.e. transporting a patient from STEMI to Emergency/ER instead of directly to the haemodynamic or making the diagnosis exaggerated, which only after performing laboratory tests of cardiac enzymes in the emergency department turned out to be a myocardial infarction, but already NSTEMI or had no relation to an acute ischaemic episode) or had no connection with incorrect EMT procedure (i.e. sudden cardiac arrest during transport to the haemodynamic or lack of consent of the patient to invasive treatment). Cases of evidently wrong rescue procedures in this respect, however, are single occurrences.

In the ESC recommendations for acute myocardial infarction with ST-segment elevation has precisely defined the significance of the patient's first contact with the health care system and the time of diagnosis of STEMI - the moment when the ST-segment elevation or its equivalent is detected in the ECG record. This time it was determined 10 minutes from the first medical contact and this is the zero point on

the treatment clock regarding the choice of reperfusion strategy [1]. In turn, the maximum delay from the point of view of a paramedic from the moment STEMI is diagnosed to the original PCI should not exceed 120 minutes. Failure to meet this time criterion requires consideration of a bolus injection or an infusion of fibrinolysis over a period of up to 10 minutes if there are no contraindications, after which such patients should be transported directly to a specialized centre in the field of invasive cardiology due to the necessity of emergency or routine PCI [10].

In the above analysis, by following the aforementioned guidelines, until the emergency medical team reached the patient, 10 minutes were added in each case, giving the recommended time for the team to perform and interpret the ECG. Due to the inability to obtain exact time parameters regarding the time which elapses from the moment of transferring the patient to the haemodynamic to the moment of opening the occluded coronary artery, 20 minutes have been subtracted from the recommended 120 minutes. This is the time that in the general opinion of specialists in the field of cardiology is sufficient to pass through the occluded artery causing myocardial infarction. In the vast majority of cases, the assumed time criterion (100 min) has been met, although these data are not fully satisfactory, because it should also include cases of patients who have been transferred to Emergency Department, what significantly reduces their chances of PCI in an acceptable time criterion, and as Anderson and Morrow point out, the rapid reperfusion of the ischaemic myocardium is the main therapeutic goal in STEMI [11]. In the Association of Cardiovascular Intervention of the Polish Cardiac Society, there are currently 165 haemodynamics providing invasive cardiology services, of which over 90% work in a 24-hour system, what in practice means that there are more than 4 haemodynamic per one million inhabitants [12]. It puts Poland on one of the first places in Europe regarding the availability of invasive treatment of ACS. However, there are still areas in which transporting a patient to perform PCI is not possible at the recommended time. One of these areas is the area of activity of the Emergency Services in Gorlice, where there is no haemodynamic, what makes it necessary to transport such a patient to the neighbouring county, and this, in turn, has a significant impact on the time lag. According to literature, based on STEMI registers, systemic delays associated with PCI exceed 120 minutes even in 58%

of patients [13]. So far there have been no special studies, considering the time to perform an ECG and its interpretation, as well as the time for coronary angiography and possible PCI, and only the time from the call or the arrival of EMT to transfer the patient to the haemodynamic. All the more this data seems to be extremely important.

The role of emergency medical teams is not limited to providing quick initial diagnosis and transporting patients to the hospital, but also includes early pre-hospital pharmacological treatment, which according to current guidelines should include antithrombotic therapy (antiplatelet and anticoagulant), symptomatic according to indications, and fibrinolytic when primary PCI is not possible at the recommended time [1]. Currently, the administration of fibrinolytic drugs is not a part of the medical rescuers' rights, which means that if the patient with symptoms of myocardial infarction cannot be transported to the invasive cardiology centre within 120 minutes, proper treatment recommended in the guidelines, involving as soon as possible fibrinolytic therapy already at pre-hospital stage, it is not possible.

Antiplatelet therapy in patients with STEMI undergoing primary PCI includes the following [1]: 1) acetylsalicylic acid (ASA) p.o. in a 150–300 mg loading dose or 75–100 mg maintenance dose if the patient was chronically taking ASA before the occurrence of infarction. It should be administered as soon as possible in all patients without absolute contraindications, which are: active bleeding, hypersensitivity to salicylates and aspirin-induced asthma [14]. Giving ASA in the ESC guidelines has received the recommendation class [I/B], which means that its use is strongly recommended. This research indicates that acetylsalicylic acid is used in the vast majority of cases (75.53%). These studies are only partially confirmed by the analysis carried out by E. Kaśiel-Ziarkowska, which shows that all patients after confirmation of myocardial infarction received 300 mg ASA [15]. Our results were also compared to the studies of M. Szpringer et al. referring to the knowledge of medical rescuers on the treatment of acute coronary syndromes. They showed that only 64.15% of rescuers would take immediate action in a patient with ACS in the form of acetylsalicylic acid [16]. According to the same research, less than 10% of paramedics did not indicate ASA as a possible antiplatelet drug that can be given in myocardial infarction,

2) P2Y<sub>12</sub> inhibitor: (ticagrelor 180 mg or prasugrel 60 mg) or clopidogrel 600 mg, if previous med-

icines are unavailable or contraindicated. It should also be used as soon as possible prior to PCI or, at the latest, during PCI (the administration of prasugrel is not recommended prior to coronary angiography). Newer antiplatelet drugs (i.e. ticagrelor and prasugrel) are now preferred because they are characterized by a faster start of treatment, greater inhibition of platelet aggregation, and better clinical outcomes than clopidogrel [10]. The use of a strong P2Y<sub>12</sub> inhibitor has received a grade [I/A] in the recommendations class. The Ordinance of the Minister of Health of April 20, 2016 grants the possibility for medical rescuers to administer clopidogrel and ticagrelor "after tele-transmission and teleconsultation with a physician assessing the ECG", whereas the administration of prasugrel in the conditions of the Polish emergency medical system is not possible [17, 18]. In own study, the use of clopidogrel over ticagrelor was definitely more frequent. These results partly confirm the data provided by Przybylski and Terejko, where the question "How often clopidogrel is used in patients with ACS", 37% of respondents answered that very often, while 30% declared that almost every time. In turn, only 3% of respondents indicated frequent use of ticagrelor [19]. The same study also looked at the availability of ticagrelor for administration by paramedics. Most, as many as 43% of respondents answered that they do not have this medication at all on the ambulance. It is worth noting that these studies were carried out after the entry into force of the above-mentioned regulation of the Minister of Health.

Both ASA and the second antiplatelet drug (clopidogrel/ticagrelor) were jointly administered in less than half of the cases, although the Working Group for revascularization of the cardiac muscle of the European Cardiac Society and the European Association of Heart and Chest Surgery (EACTS) underlines patients with STEMI undergoing primary PCI should receive ASA and a P2Y<sub>12</sub> receptor inhibitor as soon as STEMI is diagnosed [20].

Anticoagulant treatment in patients with STEMI undergoing PCI involves the administration of unfractionated heparin (HNF) before coronagraphy in a dose of 70–100 IU/kg. (max 5000 IU) i.v. or enoxaparin or bivalirudin instead of HNF, especially in patients at high risk of bleeding. Administration of HNF received the recommendation [I/C], while enoxaparin and bivalirudin the strength of recommendation [IIa/A] [10]. Of the anticoagulants administered in STEMI in accordance with the abovementioned regulation, medical rescuers are entitled to self-administer



only unfractionated heparin [17, 18]. In the study, this option was used in less than 63% of cases, which indicates evident gaps in the implementation of the STEMI recommendations in this regard.

In the analysis attention was drawn to the frequency of ECG tele-transmission system support by emergency medical teams to confirm the diagnosis and to accelerate reperfusion strategies. Failed attempts to carry out the tele-transmission due to technical reasons (i.e. including the lack of coverage) and the procedure of teleconsultation itself without tele-transmission were omitted. According to R. Ładny, in order to rationalize the results of treatment of patients with STEMI, the use of the tele-transmission system should be the standard of conduct in all patients with the suspected acute coronary syndrome. Such a procedure accelerates putting the final diagnosis and facilitates the coordination of patient transfer and reduces the delay to revascularization, which is the overriding goal [17]. E. Kaśiel-Ziarkowska received very similar results compared to these results by analysing EMT interventions to acute coronary syndromes in the Lodz region. In the analysed myocardial infarctions, tele-transmission was performed in 68% of cases [15].

### CONCLUSIONS

- 1) The time from calling the emergency medical team to reaching the place in most cases falls within the time limits set by law.
- 2) In most cases, patients who have been diagnosed with STEMI significantly delay calling the emergency medical team by more than 2 hours, therefore it is necessary to raise public awareness and knowledge about the symptoms of myocardial infarction.
- 3) The direct place of transport for the vast majority of patients with STEMI is the invasive cardiology department.
- 4) In most cases of direct transport to the haemodynamic, the time from diagnosis of STEMI to the transfer of patient was shorter or equal to 100 minutes, which gave a chance of reperfusion at the recommended time of 120 minutes.
- 5) The use of two-stage antiplatelet therapy, as well as complete antithrombotic pharmacotherapy in myocardial infarction, is insufficient to meet current recommendations in the Gorlice county, therefore it is necessary to increase the knowledge of the paramedics in this area.

- 6) Clopidogrel is a widely used antiplatelet medicine in patients with acute ST-segment elevation myocardial infarction, although it is not a P2Y<sub>12</sub> receptor of the first choice.

**Acknowledgements:** The authors would like to thank the director of the Specialist Hospital in Gorlice for permission to provide access to anonymised medical data and for administrative staff of the Ambulance Service in Gorlice.

**Conflict of interest:** The authors declare no conflict of interest. The study was conducted without any commercial or financial relationships or financial support.

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