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# Emergency Medical Care for Patients with Acute Myocardial Infarction at the Prehospital Stage

Экстренная медицинская помощь пациентам с острым инфарктом миокарда на догоспитальном этапе

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## Abstract

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**Introduction.** Despite significant advances of modern cardiology in improving the treatment of patients with coronary heart disease, its clinical form – acute myocardial infarction (AMI) is a potentially fatal event and cause of death among adults. The effectiveness of treatment, both conservative and interventional methods of AMI, depends on the time that passed from the clinical manifestations of the disease to the beginning of treatment. An urgent problem is to provide the emergency medical care (EMC) to this category of patients, because the legal responsibility for medical decisions is one of the most difficult problems in the health care system. The high level of mortality in AMI stimulates to conduct the analysis of the quality of EMC at the prehospital stage.

**Purpose.** To analyze the provision of emergency medical care for patients with acute myocardial infarction at the prehospital stage.

**Materials and methods.** The results of the study are based on the data obtained from the comprehensive examination of 280 patients with acute myocardial infarction with stable ST segment elevation and 91 patients without ST segment elevation. The sample of patients was carried out in the period from 2015 to February 2018. In the study, the STEMI group included 141 (50.4%) residents of the city and 139 (49.6%) ones of the village, the NSTEMI group consisted of 42 (46.2%) residents of the city and 49 (53.8%) ones of the village. The groups were comparable in the proportion of patients from the city and village. All the surveyed persons were comparable in age, social status, and sex (the ratio of men and women was 4 to 1).

Assessment of the quality of emergency medical care for patients with STEMI and NSTEMI at the prehospital stage was carried out according to the standard EMC protocol. Execution of the Protocol item + 1 point, non-execution – 0 points.

**Results and discussion.** The clinical feature of patients with STEMI was a more frequent complaint of anginal pain among 263 (93.9%) patients versus 76 (83.5%) ones in the NSTEMI group, ( $p < 0.05$ ). In the group of patients with NSTEMI, there was the following distribution of referrals: to emergency medical service – 40 people (43.9%), to non-core medical care with the subsequent involvement of air ambulance service – 24 (26.4%) people, to the primary health care center – 27 (29.7%) ones, while referring to the primary health care center was significantly more frequent in patients with NSTEMI, ( $p < 0.05$ ). The prescription of nitroglycerin, ASA, and clopidogrel did not have a significant difference, while  $\beta$ -blockers were more frequently prescribed in the STEMI group of 151 (53.9%) patients versus 28 (30.8%) individuals in the NSTEMI group ( $p < 0.05$ ). Anticoagulant use was much more frequent in the STEMI group than in the NSTEMI group: 245 (87.5%) people versus 68 (74.7%) patients, respectively ( $p < 0.05$ ). Significantly, narcotic analgesic was prescribed more often in the

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STEMI group of 249 (88.9%) individuals versus 61 (67.0%) patients in the NSTEMI group ( $p < 0.05$ ), which is most likely due to the clinical manifestation of AMI in the examined patients.

**Conclusions.** Referral to the primary health care center was significantly more frequent in patients with NSTEMI due to the clinical course of the disease. There is a significantly better performance of the Protocol for providing emergency medical care at the pre-hospital stage in patients with STEMI if compared to NSTEMI in terms of the following: providing venous access, prescribing a beta-blocker, narcotic analgesic, and anticoagulant. The use of non-recommended interventions in patients of both groups was comparable.

**Keywords:** coronary artery disease, emergency medical care, acute myocardial infarction, prehospital stage, the primary health care center

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### Резюме

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**Введение.** Несмотря на значительные достижения современной кардиологии в совершенствовании лечения пациентов с ишемической болезнью сердца, ее клиническая форма – острый инфаркт миокарда (ОИМ) – является потенциально фатальным событием и причиной смерти среди взрослого населения. Эффективность лечения ОИМ как консервативными, так и интервенционными методами зависит от времени, прошедшего с момента появления клинических симптомов заболевания до начала лечения. Актуальной проблемой является оказание экстренной медицинской помощи (ЭМП) этой категории пациентов, поскольку юридическая ответственность за медицинские решения является одной из самых сложных проблем в системе здравоохранения. Высокий уровень смертности при ОИМ стимулирует проводить анализ качества ЭМП на догоспитальном этапе.

**Цель.** Проанализировать оказание экстренной медицинской помощи пациентам с острым инфарктом миокарда на догоспитальном этапе.

**Материалы и методы.** Результаты исследования основаны на данных, полученных при комплексном обследовании 280 пациентов с острым инфарктом миокарда со стабильным подъемом сегмента ST и 91 пациента без подъема сегмента ST. Выборка пациентов проводилась в период с 2015 по февраль 2018 г. В исследовании в группе STEMI был 141 (50,4%) житель города и 139 (49,6%) – села, в группе NSTEMI 42 (46,2%) жителя города и 49 (53,8%) – села. Группы были сопоставимы по доле пациентов из города и села. Все обследованные лица были сопоставимы по возрасту, социальному статусу и полу (соотношение мужчин и женщин составляло 4 к 1). Оценка качества оказания неотложной медицинской помощи пациентам со STEMI и NSTEMI на догоспитальном этапе проводилась в соответствии со стандартным протоколом ЭМП. Исполнение пункта протокола +1 балл, неисполнение – 0 баллов.

**Результаты и обсуждение.** Клинической особенностью пациентов со STEMI была более частая жалоба на ангинозную боль у 263 (93,9%) пациентов против 76 (83,5%) в группе NSTEMI ( $p < 0,05$ ). В группе пациентов со NSTEMI наблюдалось следующее распределение обращений: на скорую медицинскую помощь – 40 человек (43,9%), обращение за непрофильной медицинской помощью с последующим привлечением службы санавиации – 24 (26,4%) человека, в центр первичной медико-санитарной помощи – 27 (29,7%), при этом обращение в центр первичной медико-санитарной помощи достоверно чаще встречалось у пациентов со NSTEMI ( $p < 0,05$ ). Назначение нитроглицерина, АСК и клопидогрела не имело достоверной разницы, в то время как  $\beta$ -блокаторы чаще назначались в группе STEMI – 151 (53,9%) пациенту против 28 (30,8%) человек в группе NSTEMI ( $p < 0,05$ ). Применение антикоагулянтов было значительно более частым в группе STEMI, чем в группе NSTEMI – 245 (87,5%) человек против 68 (74,7%) пациентов соответственно ( $p < 0,05$ ). Достоверно чаще наркотический анальгетик назначался в группе STEMI – 249 (88,9%) человек против 61 (67,0%) пациента в группе NSTEMI ( $p < 0,05$ ), что, скорее всего, связано с клинической манифестацией острого инфаркта миокарда у обследованных пациентов.

**Выводы.** Обращение в центр первичной медико-санитарной помощи было достоверно чаще у пациентов с NSTEMI, что обусловлено клиническим течением заболевания. Существует значительно более высокое выполнение протокола оказания экстренной медицинской помощи на догоспитальном этапе у пациентов со STEMI по сравнению с NSTEMI по пунктам: обеспечения венозного доступа, назначения  $\beta$ -блокатора, наркотического анальгетика и антикоагулянта. Применение не рекомендованных вмешательств у пациентов обеих групп было сопоставимо.

**Ключевые слова:** ИБС, экстренная медицинская помощь, острый инфаркт миокарда, догоспитальный этап, центр первичной медико-санитарной помощи.

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## ■ INTRODUCTION

Despite significant advances in modern cardiology in improving the treatment of patients with coronary heart disease, its clinical form – acute myocardial infarction (AMI) is a potentially fatal event and cause of death among adults. Sudden coronary artery occlusion leads to ischemic death of cardiomyocytes, so the time from the beginning of clinical manifestations is important for the patient, and it further determines the treatment policy [1, 2].

The effectiveness of treatment, both conservative and interventional methods of AMI depends on the time elapsed from the manifestation of clinical manifestations of the disease to the beginning of treatment. This pathology is classified by the World Health Organization as one of the most important non-communicable diseases. By definition, the acute myocardial infarction with stable ST segment elevation (STEMI) and non-ST segment elevation myocardial infarction (NSTEMI) differ only in patterns of acute ischemia and myocardial necrosis on ECG. In the future, it determines the treatment tactics, but does not affect the AMI diagnostic protocol [3, 4].

An urgent problem is to provide the emergency medical care (EMC) to this category of patients, since the legal responsibility for medical decisions is one of the most difficult problems in the health care system. The high level of mortality with AMI stimulates to conduct the analysis of the quality of EMC at the prehospital stage, in order to prevent the occurrence of conflict situations, to improve the skills of medical staff, as well as to improve medical support during the treatment process. It is also important to identify the factors that influence the patients' decisions to seek medical care. A significant factor is the medical awareness of the population, that is, the ability to recognize the symptoms of the disease in time and seek help [5].

The great need for evaluation of EMC encourages a comprehensive study of this problem. Firstly, it is necessary to analyze the causes of applying patients with AMI to the primary health care center. Secondly, the quality of medical services provided by General practitioners is one of the criteria for the effectiveness of the implementation of patient management protocols, which requires systematic analysis and appropriate researches. Thus, it is to determine the need to assess the quality of EMC provision to patients with AMI at the prehospital stage, which determined the purpose of this study [6].

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## ■ PURPOSE OF THE STUDY

To analyze the provision of emergency medical care for patients with acute myocardial infarction at the prehospital stage.

## ■ MATERIALS AND METHODS

The study is based on data obtained during a comprehensive examination of 280 patients with acute myocardial infarction with stable ST segment elevation (STEMI) and 91 patients without ST segment elevation (NSTEMI). The sample of patients was carried out in the period from 2015 to February 2018. The patients were delivered by ambulance staff to the reception and diagnostic Department of the Municipal institution "Regional medical center of cardiovascular diseases" of Zaporizhzhia Regional Council. In the study, the STEMI group included 141 (50.4%) residents of the city and 139 (49.6%) ones of the village, the NSTEMI group consists 42 (46.2%) residents of the city and 49 (53.8%) ones of the village. The groups were comparable in the proportion of patients from the city and village. All the surveyed persons were comparable in age, social status and sex (the ratio of men and women was 4 to 1).

### **Screening and distribution of patients into groups**

All patients were carefully examined for compliance with the inclusion/exclusion criteria:

Criteria for inclusion in the study: male and female patients from 46 to 75 years; for women postmenopausal period over 1 year; the presence of AMI in the first 12 hours from the onset of the disease; informed consent of the patient to engage in the study.

Criteria for exclusion from the study: atrioventricular block of II-III degree; permanent form of atrial fibrillation; detection of congenital and acquired hemodynamically significant heart defects; stage III of chronic heart failure; discovered aneurysm of the left ventricle; decompensated comorbidity; acute inflammatory diseases or exacerbation of chronic; history of coronary artery bypass grafting; oncological disease.

STEMI and NSTEMI were verified on the basis of generally accepted diagnostic criteria [7, 8]. The dividing of patients into groups was carried out after establishing the compliance of patients with the criteria for inclusion/exclusion of the study depending on the presence of persistent ST-segment elevation:

- the first group included 280 patients with STEMI (median age was 60.0 [53.0; 64.0] years);
- the second group consists of 91 patients with NSTEMI (median age was 61.0 [56.0; 66.0] years).

### **The algorithm of EMC**

Assessment of the quality of emergency medical care for patients with STEMI and NSTEMI at the prehospital stage was carried out according to the standard EMC protocol [9, 10]. Assessment of treatment policy was carried out on the following points of the EMC protocol: determination of blood saturation ( $SpO_2$ ); provision of reliable venous access of catheters for intravenous puncture; appointment of nitroglycerin in aerosol (1–2 doses or 0.4–0.8 mg); use of acetylsalicylic acid (ASA) by chewing 160–325 mg;

use of clopidogrel 300 mg orally; appointment of  $\beta$ -adrenoblocker; narcotic analgesic; anticoagulant. Execution of the Protocol item +1 point, non-execution – 0 points.

### Statistical processing of the results

Statistical processing of the obtained data was carried out on a personal electronic computer using the application software package PSPP (version 0.7.9, GNU GPL license). The data contains the number of patients (n) and the proportion of the total number of patients (%). When testing statistical hypotheses, the null hypothesis was rejected at a level of statistical significance (p) below 0.05. Statistical data processing was carried out using nonparametric criterion  $\chi^2$ .

## ■ RESULTS AND DISCUSSION

Clinical manifestations of AMI among examined STEMI and NSTEMI patients were evaluated retrospectively at the onset of the disease. There were complaints such as angina, weakness, palpitations, hyperhidrosis, shortness of breath, nausea, dizziness. The analysis of complaints in the examined patients is presented in table 1.

The incidence of major symptoms among STEMI patients was as follows: angina – 263 people (93.9%), weakness – 90 (32.1%), palpitation – 6 (2.1%), hyperhidrosis – 44 (15.7%), shortness of breath – 21 (7.5%), nausea – 25 (13.9%), dizziness – 13 (4.6%). In the group of patients with NSTEMI was the following distribution of symptoms: angina – 76 people (83.5%), weakness – 23 (25.3%), palpitations – 5 (5.5%), hyperhidrosis – 8 (8.8%), shortness of breath – 12 (13.2%), nausea – 8 (8.8%), dizziness – 6 (6.6%). There were no significant differences in the frequency of clinical manifestations of AMI,

**Table 1**  
The main clinical manifestations among the examined patients (n=371)

Symptom	STEMI (n=280)		NSTEMI (n=91)	
	Number of patients	%	Number of patients	%
Angina	263	93.9%	76	83.5%
P-value	$\chi^2$ , p=0.004			
Weakness	90	32.1%	23	25.3%
P-value	$\chi^2$ , p=0.27			
Palpitation	6	2.1%	5	5.5%
P-value	$\chi^2$ , p=0.20			
Hyperhidrosis	44	15.7%	8	8.8%
P-value	$\chi^2$ , p=0.14			
Shortness of breath	21	7.5%	12	13.2%
P-value	$\chi^2$ , p=0.15			
Nausea	25	8.9%	8	8.8%
P-value	$\chi^2$ , p=0.86			
Dizziness	13	4.6%	6	6.6%
P-value	$\chi^2$ , p=0.65			

**Table 2**  
**Referral for hospitalization of patients with acute coronary syndrome**

Referral for hospitalization	STEMI (n=280)		NSTEMI (n=91)	
	Number of patients	%	Number of patients	%
EMS	152	54.2%	40	43.9%
P-value	$\chi^2$ , p=0.11			
AAS	106	37.9%	24	26.4%
P-value	$\chi^2$ , p=0.06			
PHCC	22	7.9%	27	29.7%
P-value	$\chi^2$ , p<0.001			

such as weakness, palpitation, hyperhidrosis, shortness of breath, nausea, dizziness ( $p>0.05$ ). The clinical feature of patients with STEMI was a more frequent complaint of anginal pain among 263 (93.9%) patients versus 76 (83.5%) ones in the NSTEMI group, ( $p<0.05$ ).

Referral for hospitalization of patients with AMI in a specialized hospital can occur in three ways: when seeking to emergency medical services (EMS), referring to a non-core medical institution, followed by a call to air ambulance service (AAS) and referring to the primary health care center (PHCC), which determined further subgroups for analysis. Referral for hospitalization of patients is presented in table 2.

The proportion of patients in the STEMI group seeking EMS was as follows: to EMS – 152 people (54.2%), referring to a non – core medical institution with subsequent use of AAS – 106 (37.9%) people, to PHCC – 22 (7.9%) patients. In the group of patients with NSTEMI there was the following distribution of referrals: to EMS – 40 people (43.9%), referral to non-core medical with the subsequent involvement of AAS – 24 (26.4%) ones, to PHCC – 27 (29.7%) people. There were no significant differences between the STEMI and NSTEMI groups with the proportion of patients seeking treatment with EMS and non-core medical institution followed by AAS ( $p>0.05$ ), while referring to PHCC was significantly more frequent in patients with NSTEMI, ( $p<0.05$ ).

The EMC Protocol scores were summed, and the proportion of appointments from the number of patients was calculated. The results are presented in table 3.

In the STEMI group, SpO<sub>2</sub> was detected in 190 (67.9%) patients and did not significantly differ from the NSTEMI group in the number of studies of 71 (78.0%) patients ( $p>0.05$ ). Venous catheter insertion was considerably more frequent in the STEMI group than in the NSTEMI group – 215 (76.8%) ones vs. 38 (41.8%) people, respectively ( $p<0.05$ ).

The prescription of nitroglycerin, ASA and clopidogrel did not have a big difference, while  $\beta$ -blockers were more frequently prescribed in the STEMI group of 151 (53.9%) patients versus 28 (30.8%) individuals in the NSTEMI group ( $p<0.05$ ). Anticoagulant use was much more frequent in the STEMI group than in the NSTEMI group 245 (87.5%) people versus 68 (74.7%) patients, respectively ( $p<0.05$ ). Significantly, narcotic analgesic was prescribed more often in the STEMI group of 249 (88.9%) individuals

**Table 3**  
Provide the emergency medical care for patients at the prehospital stage (n=371)

Implementation of the Protocol	STEMI (n=280)		NSTEMI (n=91)		P-value
	1		2		
	n	%	n	%	
Determination SpO <sub>2</sub>	190	67.9%	71	78.0%	$\chi^2$ , p=0.07
Venous access	215	76.8%	38	41.8%	$\chi^2$ , p<0.001
Nitroglycerin	218	77.9%	64	70.3%	$\chi^2$ , p=0.14
ASA	267	95.4%	87	95.6%	$\chi^2$ , p=0.92
Clopidogrel	189	67.5%	53	58.2%	$\chi^2$ , p=0.92
$\beta$ -adrenoblocker	151	53.9%	28	30.8%	$\chi^2$ , p<0.001
Narcotic analgesic	249	88.9%	61	67.0%	$\chi^2$ , p<0.001
Anticoagulant	245	87.5%	68	74.7%	$\chi^2$ , p=0.004

versus 61 (67.0%) patients in the NSTEMI group (p<0.05), which is most likely due to the clinical manifestation of AMI in the examined patients. Angina pain considerably prevailed in the STEMI group – 263 (93.9%) people versus 76 (83.5%) patients in the NSTEMI group (p<0.05).

It should be noted that the introduction of a combination of sodium metamizole with diphenhydramine hydrochloride intramuscularly was used in 34 (12.1%) cases in the STEMI group and 5 (5.5%) cases in the NSTEMI group and did not reach the level of statistical significance (p>0.05). Thus, the use of unauthorized third party interventions in patients of both groups was correspond.

The anticoagulants used among patients were summed, and the proportion of appointments from the number of patients was calculated. The results are presented in table 4.

Enoxaparin used at the prehospital considerably more frequent in the NSTEMI group than in the STEMI group – 33 (48.5%) ones vs. 82 (33.5%) people, respectively (p<0.05). In the STEMI group, Fondaparinux used for 72 (29.4%) patients and did not significantly differ from the NSTEMI group in the proportion of 27 (39.7%) patients (p>0.05). Heparin use was much more frequent in the STEMI group than in the NSTEMI group 91 (37.1%) people versus 8 (11.8%) patients, respectively (p<0.05).

Assessment of the quality of EMS is an important component of medical services. Competition for both public and private financial resources poses a challenge for medical institutions to ensure competitive advantage. The key mechanism for increasing the quality of EMS in modern conditions is

**Table 4**  
The anticoagulants used among patients at the prehospital stage (n=313)

Anticoagulant	STEMI (n=245)		NSTEMI (n=68)		P-value
	1		2		
	n	%	n	%	
Enoxaparin	82	33.5%	33	48.5%	$\chi^2$ =0.02
Fondaparinux	72	29.4%	27	39.7%	$\chi^2$ , p=0.11
Heparin	91	37.1%	8	11.8%	$\chi^2$ , p<0.001

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the adaptation of the health care system in accordance with international standards [11].

According to K.A. Eagle et al. compliance with the Protocol of care according to standardized guidelines greatly reduces the mortality of patients with acute myocardial infarction. The authors also reported that this reduces the cost of medical care [12].

Implementation of emergency medical care in the practice of the EMS in accordance with modern scientific recommendations is a complex process that is influenced by various factors. It is important to implement the recommendations to training all primary care physicians who provide care to patients with AMI [13].

It should be noted that the main strategic direction in improving the quality of EMS in the first place should be the provision of medicines and equipment for primary health care. The constant improvement of approaches to the organization and implementation of treatment of patients with AMI, taking into account the socio-economic problems of the population are significant as well [14].

Thus, the development of a model for assessing the quality of EMS is an important area of scientific research. The obtained results can later be the basis for further research and development of an optimal model for assessing the quality of EMS for patients with AMI at the prehospital stage.

## ■ CONCLUSIONS

1. Referral to PHCC was significantly more frequent in patients with NSTEMI, due to the clinical course of the disease.
2. There is a significantly better performance of the Protocol for providing EMC at the pre-hospital stage in patients with STEMI compared to NSTEMI in terms of: providing venous access, prescribing a beta-blocker, narcotic analgesic and anticoagulant.
3. The use of non-recommended interventions in patients of both groups was comparable.

### **Prospects of further research**

The system of providing EMC at the pre-hospital stage requires the development of an optimal model for assessing the quality of medical care. Further research is needed to identify EMC defects and assess their impact on the treatment of patients with AMI. It is interesting to assess the quality of EMC in dynamics, which will not only analyze the level of care provided, but also in the future will improve the skills of visiting emergency medical teams, as well as improve the medical support of the treatment process.

**The authors declare no conflict of interests.**

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