УДК 616.127-005.8-085-035-053.9
DOI: 10.35693/2500-1388-2023-8-1-29-33

The management of patients aged 90 years and older with ST-segment elevation myocardial infarction

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Abstract

Aim – to study in-hospital outcomes in patients with ST-segment elevation myocardial infarction (STEMI) in the age group over 90 years old, depending on the treatment tactics.

Material and methods. For the period of January, 2017 - December, 2020, in total 72 patients aged ≥ 90 were hospitalized in Samara Regional Clinical Cardiology Dispensary with STEMI: mean age 91.8 years (90-96), among them 49 women (68%). Patients were divided into two groups depending on the chosen treatment strategy. Group 1 included patients (n = 13) who underwent coronary angiography and primary percutaneous coronary intervention (pPCI), mean age 90.6 (90-91) years, 8 women (61.5%). Group 2 included patients who received coronary angiography and conservative treatment (n = 5) and only conservative treatment (n = 54), mean age 91.9 (91-96) years, 41 women (69.5%).

Results. In terms of the incidence of pulmonary edema and cardiogenic shock, both groups were comparable, no statistically significant differences were found. In-hospital mortality among STEMI patients aged 90 years and older was higher in the conservative treatment group than in the invasive group (45.8% vs. 7.7%) (OR 10.12; 95% CI (1.24–82 .96)).

Conclusion. The results obtained in our study may indicate the advantage of the invasive strategy in the treatment of patients with STEMI over the age of 90 years. Further prospective studies based on the principles of evidence-based medicine are required.

Keywords: STEMI, reperfusion therapy, elderly, nonagenarians.

Conflict of interest: nothing to disclose.

Citation
Duplyakova PD, Pavlova TV, Khokhlunov SM, Duplyakov DV. **The management of patients aged 90 years and older with ST-segment elevation myocardial infarction.** *Science and Innovations in Medicine.* 2023;8(1):29-33.
doi: 10.35693/2500-1388-2023-8-1-29-33

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Received: 31.10.2022
Revision Received: 11.12.2022
Accepted: 13.12.2022

The limitations of the study are the retrospective design and the participation of patients from the same medical center.

Выбор оптимальной тактики ведения пациентов с инфарктом миокарда с подъемом сегмента ST в возрастной группе старше 90 лет

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Аннотация

Цель – изучение госпитальных исходов у пациентов с ИМпST старше 90 лет в зависимости от тактики ведения.

Материал и методы. За период 01.2017–12.2020 гг. в Самарский областной кардиологический диспансер им. В.П. Полякова было госпитализировано 72 пациента с диагнозом ИМпST в возрастной группе старше 90 лет, средний возраст 91,8 года (90–96), женщин 49 (68%). Пациенты были разделены на две группы в зависимости от выбранной стратегии ведения. Группа 1 включала пациентов с проведенным пЧКВ (n=13), средний возраст 90,6 (90–91) года, женщин 8 (61,5%). В группу 2 вошли пациенты с проведенной КГ (n=5) и консервативной тактикой ведения (n=54), средний возраст 91,9 (91–96) года, женщин 41 (69,5%).

Результаты. По частоте развития отека легких и кардиогенного шока обе группы были сопоставимы, статистически значимых различий выявлено не было. Госпитальная летальность среди пациентов с ИМпSTв возрасте 90 лет и старше была выше в группе консервативной стратегии по сравнению с группой инвазивной тактики – 45,8% против 7,7% (ОШ 10,12; 95% ДИ (1,24–82,96)).

Выводы. Результаты свидетельствуют о преимуществе инвазивной тактики ведения пациентов с ИМпST в возрасте старше 90 лет. Требуется дальнейшее проведение проспективных исследований, построенных на принципах доказательной медицины.

Ключевые слова: ИМпST, реперфузионная терапия, пожилые, девяностолетние.

Конфликт интересов: не заявлен.

Для цитирования:
Дуплякова П.Д., Павлова Т.В., Хохлунов С.М., Дупляков Д.В. **Выбор оптимальной тактики ведения пациентов с инфарктом миокарда с подъемом сегмента ST в возрастной группе старше 90 лет.** *Наука и инновации в медицине.* 2023;8(1): 29-33.
doi: 10.35693/2500-1388-2023-8-1-29-33

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ИБС – ишемическая болезнь сердца, ИМ – инфаркт миокарда, ИМпST – инфаркт миокарда с подъемом сегмента ST, КГ – коронарная ангиография, ОКС – острый коронарный синдром, пЧКВ – первичное чрескожное коронарное вмешательство, РКИ – рандомизированное клиническое исследование, ССЗ – сердечно-сосудистые заболевания, ТЛТ – тромболитическая терапия, ЧКВ – чрескожное коронарное вмешательство, АГ – артериальная гипертония, ЗПА – заболевание периферических артерий, ПИМ – перенесенный инфаркт миокарда, СД – сахарный диабет, ФП – фибрилляция предсердий, ХБП – хроническая болезнь почек, ХСН – хроническая сердечная недостаточность, ВТК – ветвь тупого края, ДА – диагональная артерия, ИМА – интермедиарная артерия, ЛК – левая коронарная артерия, ОА – огибающая артерия, ПКА – правая коронарная артерия, ПМЖВ – передняя межжелудочковая ветвь, АМК – антагонисты минералокортикоидных рецепторов, АСК – ацетилсалициловая кислота, ББ – бета-блокаторы, БКК – блокаторы кальциевых каналов, иАПФ – ингибиторы ангиотензин-превращающего фермента, ПОАК – пероральные антикоагулянты, P2Y12 – блокаторы рецепторов тромбоцитов.

Ограничения исследования – ретроспективный дизайн и участие пациентов из одного медицинского центра.

Рукопись получена: 31.10.2022
Рецензия получена: 11.12.2022
Решение о публикации принято: 13.12.2022

BACKGROUND

Ischemic heart disease (IHD) is a major cause of lethal outcomes worldwide. According to statistical data for 2018, in the Russian Federation, IHD accounted for more than half (52.6%) of the mortality from diseases of the circulatory system [1]. Myocardial infarction (MI) accounts for approximately 90% of all acute forms of IHD [2].

Currently, reperfusion treatment is recommended to reduce the risk of death in patients with ST segment elevation myocardial infarction (STEMI), which involves the use of two strategies: primary percutaneous coronary intervention (pPCI) and a pharmacoinvasive approach including sequential thrombolytic therapy (TLT) and PCI [3].

Approximately one-third of all patients with acute coronary syndrome (ACS) are older and senile [4]. According to the age classification adopted by the World Health Organization, people aged 75–90 years are classified as old, and those aged >90 years are classified as long livers. Currently, 6% of the global population are old, and by 2050, the proportion of the older population in Western countries is projected to reach 11.5%, mainly due to the rapid increase in the proportion of people aged >80 years [5]. Aging is a natural, progressive process that affects all body systems, including the cardiovascular system. With aging, structural, and functional changes occur at the cellular and subcellular levels, which spread to the entire cardiovascular system. Endothelial function is disrupted, atherosclerotic processes progress, the muscular layer of the arteries becomes atrophied and inelastic, myocardial sclerosis develops with the disruption of its systolic and diastolic functions, and metabolic disorders increase, which creates conditions for energetic and dynamic failure of the heart under stress conditions. In old age, conditioned, and unconditioned reflexes of blood circulation regulation are weakened, which is accompanied by the inertia of vascular reactions. All these processes contribute to the occurrence and progression of cardiovascular diseases (CVDs).

The abovementioned aspects of CVD development in older age groups can influence not only the course of various forms of IHD but also the approaches to their treatment. Thus, older patients with STEMI receive reperfusion therapy (TLT and/or PCI) less often [6], and the most common reasons for refusal include late admission, atypical symptoms, previously diagnosed multivessel disease, comorbidity, reduced renal function, and fragility. In addition, pPCI in these age groups was associated with an increased risk of complications during the intervention compared with that in younger patients. Older patients with STEMI are also at a higher risk of death from ischemic and nonischemic events because of the high incidence of severe comorbidities. The current lack of a special evidence base for the management of patients aged >75 years with STEMI is an important factor that contributes to the decrease in the frequency of reperfusion treatment among older patients because of their rare inclusion in large randomized controlled trials (RCTs). In addition, the pathophysiological aspects of the development and CVD course in older age groups do not enable us to interpolate the results of RCTs obtained in younger patients. From the viewpoint of the basic principles of evidence-based medicine, the most reliable and practically applicable data on optimal treatment approaches and outcomes in older patients with senility and STEMI can be obtained through prospective registries.

AIM

This study examined hospital outcomes in patients with STEMI aged >90 years depending on the management approach.

MATERIAL AND METHODS

From January 2017 to December 2020, 13,272 patients were hospitalized with ACS at the V.P. Polyakov Samara Regional Clinical Cardiological Dispensary. Of these, 4086 patients were diagnosed with STEMI (**Fig. 1**).

STEMI was established based on clinical symptoms (including persistent anginal pain) suggestive of myocardial ischemia and changes in the 12-lead electrocardiogram. Electrocardiographic criteria for acute coronary artery occlusion included new J-point ST segment elevations in two contiguous leads of 2.5 mm in men aged 40 years or 1.5 mm in women in leads V2–V3 and/or 1 mm in other leads (in the absence of left ventricular hypertrophy or left bundle branch block), as well as the appearance of a new left bundle branch block. High-sensitivity troponin I levels were measured to confirm myocardial necrosis in STEMI [5].

During the specified period, 72 patients aged >90 years were hospitalized for STEMI. The average time from the first medical contact to the delivery to the PCI center was 104 min. All patients were assessed upon admission from the standpoint of the possibility of using an invasive management approach. Consequently, coronary angiography (CA) was performed in 18 patients, and in 13 cases, it resulted in pPCI. The remaining patients were not subjected to the invasive approach (n = 54); three patients were hospitalized after ≥24 h from the onset of pain, three were diagnosed with acute renal failure, one had gastrointestinal bleeding, one was diagnosed with thrombocytopenia, six had contraindications to intervention because of the severity of their general condition, and another 40 patients signed a refusal to undergo CA.

Thus, the patients were divided into two groups depending on their management approach in the hospital. Group 1 included patients who underwent pPCI (n = 13), with a mean age of 90.6 (90–91) years, and 8 (61.5%) patients were female. Group 2 included patients who were treated conservatively, including those who underwent CG without subsequent PCI (n = 5). Group 2 included 59 patients, with a mean age of 91.9 (91–96) years, and 41 were women (69.5%). Outcomes were assessed during hospitalization.

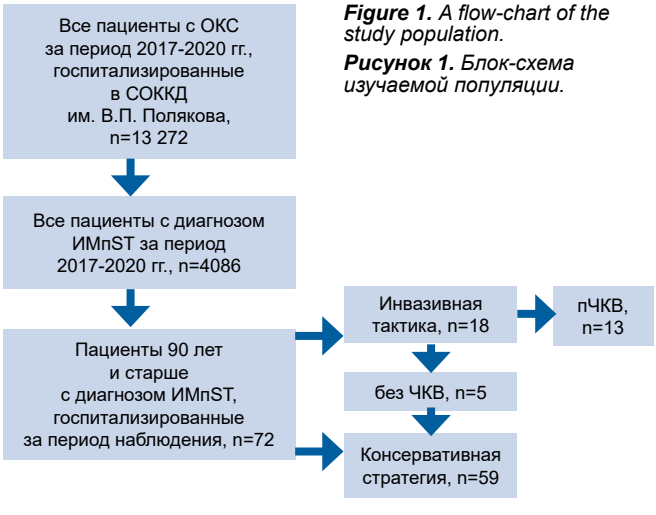

Figure 1. *A flow-chart of the study population.*

Рисунок 1. *Блок-схема изучаемой популяции.*

	Group 1	Group 2	p
Female, n	8 (61,5%)	41 (69,5%)	0,74
Age, years	90,6 [90-91]	91,9 [91-96]	0,003
RMI (recurrent myocardial infarction)	3 (23,1%)	21 (35,6%)	0,52
CHF (chronic heart failure)	4 (30,8%)	23 (38,9%)	0,76
History of stroke	3 (23,1%)	8 (13,6%)	0,41
PVD (peripheral vascular disease)	1 (7,7%)	8 (13,6%)	1,00
Chronic kidney disease (CKD) (stages 4 and 5)	4 (30,8%)	13 (22,0%)	0,49
Smoking	0	0	-
Diabetes mellitus	2 (15,4%)	8 (13,6%)	1,00
AH (arterial hypertension)	13 (100%)	56 (94,9%)	1,00
AF (atrial fibrillation)	4 (30,8%)	15 (25,4%)	0,73

Note: The difference in indicators is statistically significant at p < 0.05.

Table 1. *Clinical characteristics of STEMI patients aged 90 years and older*

Таблица 1. *Клиническая характеристика пациентов с ИМпST 90 лет и старше*

Statistical analysis was performed using IBM SPSS Statistics version 26 (IBM Corp., Armonk, USA). When calculating descriptive statistics, quantitative variables were assessed for compliance with a normal distribution using the Shapiro–Wilk or Kolmogorov–Smirnov test. Continuous variables with a distribution close to normal were presented as the mean (M) ± standard deviation (σ); if the distribution of the variable differed from the normal distribution, the median and quartiles (Me [Q1; Q3]) were given. Fisher's exact test was used to compare frequencies between the groups. The cutoff threshold for the level of significance when testing statistical hypotheses was chosen to be $p < 0.05$.

RESULTS

The baseline clinical characteristics of patients with STEMI are presented in **Table 1**. The invasive group was younger than the conservative group (mean age, 90.6 vs 91.9 years, p = 0.003). No significant differences were found between the groups in other parameters.

CG was performed mainly through radial access (94.4%). The characteristics of the coronary anatomy are presented in **Table 2**. Three-vessel coronary artery lesions were the most common (61%) (**Fig. 2**).

Optimal drug therapy was prescribed to all patients included in the study. To reduce the risk of death, recurrent MI, and ischemic events, in the absence

AIVB (anterior interventricular branch)	12 (66,6%)
RCA (right coronary artery)	13 (72,2%)
CA (circumflex artery)	6 (33,3%)
LCA trunk (left coronary artery trunk)	1 (5,6%)
IMA (intermediary artery)	1 (5,6%)
DA (diagonal artery)	1 (5,6%)
OMA (obtuse marginal artery)	1 (5,6%)

Table 2. *Anatomical lesions of coronary arteries in patients with STEMI aged 90 years and older*

Таблица 2. *Анатомическое поражение коронарных артерий у пациентов с ИМпST в возрасте 90 лет и старше*

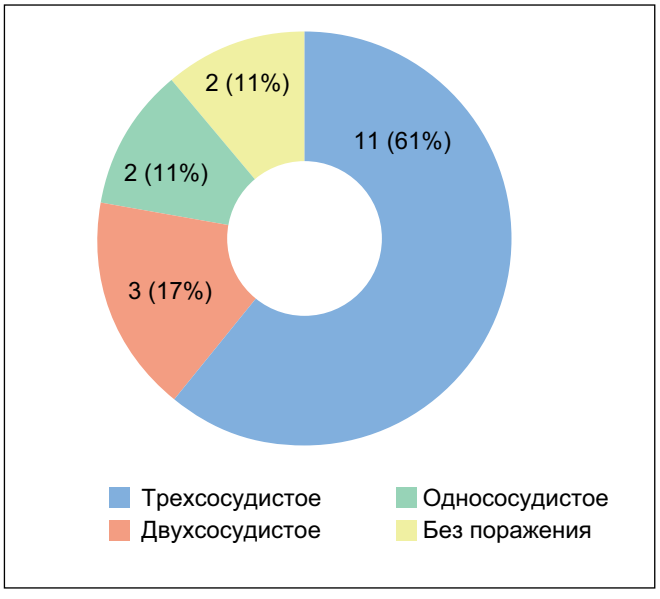

Figure 2. *The prevalence of coronary lesion in STEMI patients over 90 years of age.*

Рисунок 2. *Распространенность поражения коронарного русла у пациентов с ИМпST старше 90 лет.*

of contraindications, dual antiplatelet therapy with acetylsalicylic acid and P2Y12 receptor blockers was prescribed. To reduce the risk of MI complications and improve prognosis, beta blockers were prescribed. Renin–angiotensin–aldosterone system blockers were prescribed to prevent left ventricular dysfunction, heart failure, and death. In the absence of contraindications, lipid-lowering therapy with a hydroxymethylglutaryl-coenzyme A reductase inhibitor during hospitalization was used to reduce the total risk of ischemic events. The need to take nitrates, diuretics, mineralocorticoid receptor antagonists, and calcium channel blockers was based on clinical characteristics (**Fig. 3**).

Regarding the incidence of pulmonary edema and cardiogenic shock, both groups were comparable, with no statistically significant differences detected. In-hospital mortality among patients with STEMI aged

	Group 1	Group 2	p	OR, 95% CI
Pulmonary edema	2 (15,3%)	9 (15,4%)	1,00	0,99 (0,19-5,24)
Cardiogenic shock	1 (7,7%)	16 (27,1%)	0,17	4,47 (0,54-31,17)
Hospital mortality	1 (7,7%)	27 (45,8%)	0,01	10,12 (1,24-82,96)

Note: The difference in indicators is statistically significant at p < 0.05.

Table 3. *In-hospital outcomes among patients with STEMI ≥90 years*

Таблица 3. *Исходы пациентов старше 90 лет с ИМпST*

90 years was higher in the conservative strategy group than in the invasive group, namely, 45.8% versus 7.7% (OR 10.12; 95% CI [1.24–82.96]) (**Table 3**).

DISCUSSION

According to the recommendations of the Russian Society of Cardiology (2020), the treatment for patients with STEMI is based on the elimination of acute occlusion and restoration of the patency of the coronary arteries. All patients, regardless of age, should be considered candidates for reperfusion therapy [2]. The European guidelines for the management of patients with STEMI (2017) indicate the absence of age restrictions for reperfusion therapy, particularly pPCI [3]. However, in real clinical practice, the invasive approach is chosen less frequently in older patients than in younger ones [7]. As a rule, this occurs because of the presence of numerous comorbidities and an often questionable prognosis in patients aged 75 years. In addition, the lack of RCTs conducted among patients in this age cohort reduces the commitment of doctors to the selection of an invasive approach for patient management.

The choice of the management approach for older patients with STEMI has long been of interest to researchers worldwide. One of the first studies (2002), including 87 patients aged >75 years, diagnosed with STEMI, showed the benefits of pPCI in reducing mortality, reinfarctions, and recurrent strokes compared with streptokinase TLT (OR 4.3; 95% CI 1.2–20.0; p = 0.01) [8].

The TRIANA multicenter, randomized, open-label study included 266 patients with STEMI aged >75 years who were hospitalized within 6 h of pain onset. Patients were divided into groups depending on whether they received pPCI (n = 132, 74 female patients, mean age 81.2 ± 4.6 years) or TLT (n = 134, 76 female patients, mean age 81 ± 4.3 years). The study did not reveal statistically significant differences in the occurrence of the combined primary endpoint (30-day

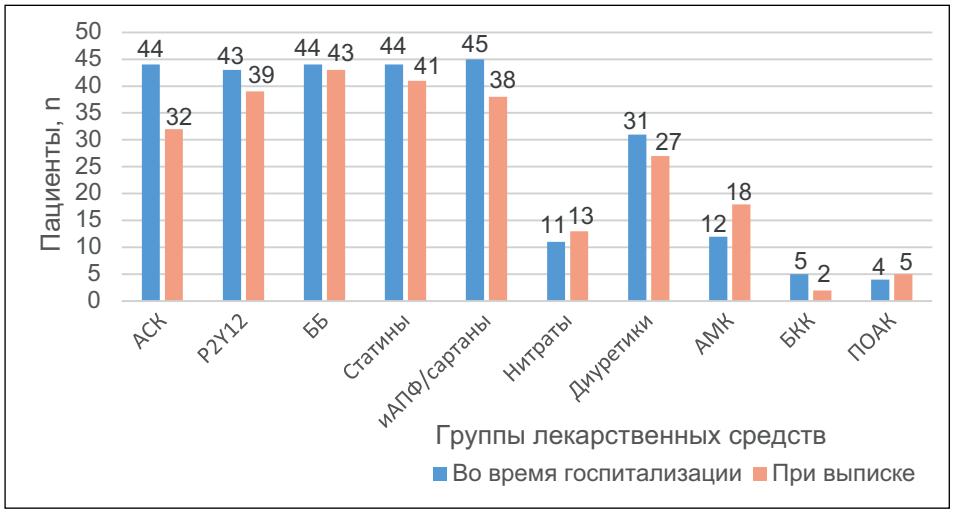

Figure 3. *The drug therapy during hospitalization and at discharge.*

Рисунок 3. *Медикаментозная терапия пациентов в стационаре и при выписке.*

death, recurrence of infarction or stroke) in the pPCI and TLT groups (OR 0.69; 95% CI 0.38–1.23; p = 0.21) [9]. In contrast, a pooled analysis including the Zwolle (2002), SENIORPAMI (2010), and TRIANA (2010) studies showed the benefits of pPCI compared with TLT in reducing lethal outcomes, recurrent infarction, and stroke in older patients with STEMI (OR 0.64; 95% CI 0.45–0.91) [9].

The EUROTRANSFER registry included 1650 patients with STEMI and a history of pPCI, who were divided into four groups according to age (<65, 65–74, 75–84, and >85 years). This study established the characteristics of treatment and outcomes in patients with STEMI with respect to age. In the group aged >85 years, an increase in the incidence of multivessel disease and a decrease in the incidence of PCI were noted. The incidence of death, recurrent infarctions, and all adverse cardiovascular outcomes increased with age (3.8% for the population aged <65 years versus 20.4% for those aged >85 years, p < 0.0001). In addition, age was an independent predictor of 30-day mortality [10].

The ISACS-TC registry identified factors associated with lower CG rates in older patients. Based on an analysis of 1315 patients with STEMI (mean age, 79.6 (76–82) years, 47.9% female patients), PCI was performed significantly less often in those aged >75 years compared with younger patients (62.1% vs 78.9 %, p < 0.001). Refusal of invasive treatment in patients aged >75 years was associated with existing risk factors, severity of symptoms, and late hospitalization. Predictors of failure to perform CA were female sex, presence of concomitant diseases, and late hospitalization [11].

The results of this study indicate the advantage of the invasive approach in the management of patients with STEMI aged >90 years, which is consistent with the results of some of the studies presented above [9, 10]. However, to date, there is no consensus on the advantage of an invasive treatment strategy in older patients and long livers. Therefore, a prospective randomized multicenter study that will provide verifiable information on the choice of the optimal approach to the management of this category of patients is considered appropriate.

CONCLUSIONS

According to the results of this study, PCI should be considered the main management strategy in patients with STEMI aged >90 years. Further prospective studies based on the principles of evidence-based medicine are required.

The study limitations are the retrospective design and enrollment of patients from a single medical center.

***Conflict of** interest. The authors declare no conflict of interest.*

ЛИТЕРАТУРА / REFERENCES

1. Rosstat data as of 06.22.2019. (In Russ.). [Данные Росстата на 22.06.2019]. URL: https://www.gsk.ru

2. 2020 *Clinical practice guidelines for Acute ST-segment elevation myocardial infarction.* (RSC) Russian Society of Cardiology. (In Russ.). [*Острый инфаркт миокарда с подъемом сегмента ST электрокардиограммы. Клинические рекомендации 2020.* Российское кардиологическое общество, Ассоциация сердечно-сосудистых хирургов России. *Российский кардиологический журнал.* 2020;25(11):4103]. doi: 10.15829/1560-4071-2020-4103

3. Ibanez B , James S, Agewall S, et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). *Eur Heart J*. 2018;39(2):119-177. doi: 10.1093/eurheartj/ehx393

4. De Luca L, Olivari Z, Bolognese L, et al. Decade of Changes in Clinical Characteristics and Management of Elderly Patients with NonST-Elevation Myocardial Infarction Admitted in Italian Cardiac Care Units. *Open Heart.* 2014;1(1):e000148. doi: 10.1136/openhrt-2014- 000148

5. Nuccia Morici, Stefano De Servi, Leonardo De Luca, et al. Management of acute coronary syndromes in older adults. *Eur Heart J*. 2022;43(16):1542-1553. doi: 10.1093/eurheartj/ehab391

6. Stenestrand U, Wallentin L. Register of Information and Knowledge About Swedish Heart Intensive Care Admissions (RIKS-HIA). Fibrinolytic therapy in patients 75 years and older with ST-segment-elevation myocardial infarction: one-year follow-up of a large prospective cohort. *Arch Intern Med.* 2003;163:965-971. doi: 10.1001/archinte.163.8.965

7. Kochergina AM. Management for acute coronary syndrome in the elderly. Problems and solutions. *Ateroscleroz*. 2013;9(3-4):65-72. (In Russ.). [Кочергина А.М. Ведение пациентов пожилого и старческого возраста с острым коронарным синдромом. Проблемы и пути решения. *Атеросклероз.* 2013;9(3-4):65-72].

8. de Boer M-J, Ottervanger J-P, van't Hof AWJ, et al. Zwolle Myocardial Infarction Study Group. Reperfusion therapy in elderly patients with acute myocardial infarction: a randomized comparison of primary angioplasty and thrombolytic therapy. *J Am Coll Cardiol*. 2002;39:1723-1728. doi: 10.1016/s0735-1097(02)01878-8

9. Bueno H, Betriu A, Heras M, et all. Primary angioplasty vs. fibrinolysis in very old patients with acute myocardial infarction: TRIANA (TRatamiento del Infarto Agudo de miocardioeNAncianos) randomized trial and pooled analysis with previous studies. *Eur Heart J*. 2011;32:51-60. doi: 10.1093/eurheartj/ehq375

10. Dziewierz A, Siudak Z, Rakowski T, et al. Age-related differences in treatment strategies and clinical outcomes in unselected cohort of patients with ST-segment elevation myocardial infarction transferred for primary angioplasty. *J Thromb Thrombolysis*. 2012;34:214-221. doi: 10.1007/s11239-012-0713-y

11. Câlmâc L, Bătăilă V, Ricci B, et al. Factors associated with use of percutaneous coronary intervention among elderly patients presenting with ST segment elevation acute myocardial infarction (STEMI): results from the ISACS-TC registry. *Int J Cardiol*. 2016;217:S21-S26. doi: 10.1016/j.ijcard.2016.06.227