REVIEW ARTICLE

CONTENTS

The level of use of cardiovascular interventions in the treatment of patients with acute myocardial infarction in Ukraine

Gennadiy O. Slabkiy[1], Victoria J. Bilak-Lukyanchuk[1], Rostislav L. Kartavtsev[2], Vitalii Kondratskyi[3], Svitlana V. Dudnik[4]

[1] UZHHOROD NATIONAL UNIVERSITY, UZHHOROD, UKRAINE
[2] STATE UKRAINIAN ASSOCIATION "POLYTECHMED", KYIV, UKRAINE
[3] CARDINAL STEFAN WYSZYNSKI UNIVERSITY, WARSAW, POLAND
[4] BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

Aim: To investigate the level of use of cardiovascular interventions during the treatment of patients with acute myocardial infarction in Ukraine.

Materials and Methods: Materials: statistical data of the National Health Service of Ukraine for the period 2021-2023 in regional aspect. Methods: bibliosemantic, medico-statistical, of structural-and-logical analysis.

Conclusions: In Ukraine, there is a tendency to increase the level of use of these technologies in the treatment of patients with acute myocardial infarction. Reliable differences in the level of use of cardiovascular interventions in the treatment of patients with acute myocardial infarction across the regions of Ukraine were reveale. A critically low level of use of these technologies is observed in the territories temporarily occupied by Russian troops since 2014 – Donetsk and Luhansk regions.

KEY WORDS: acute myocardial infarction, treatment, cardiovascular interventions

Wiad Lek. 2025;78(2):456-462. doi: 10.36740/WLek/200415 DOI

INTRODUCTION

Myocardial infarction is a serious complication of ischemic (coronary) heart disease and hypertension, which leads to a high level of disability and mortality of the working-age population in most developed countries of the world. This indicator at the age of 50–54 years is 404–367 per 100,000 population [1-3].

A modern effective method of treating patients with myocardial infarction is the use of cardiovascular interventions with stenting of coronary vessels [4]. The use of cardiovascular interventions during the treatment of patients with acute myocardial infarction contributes to increasing the effectiveness of treatment results and reducing patient mortality.

This type of medical care in Ukraine is included in the package of state medical guarantees [5].

AIM

The aim is to investigate the level of use of cardiovascular interventions during the treatment of patients with acute myocardial infarction in Ukraine.

MATERIALS AND METHODS

Object of the study: use of cardiovascular interventions in the treatment of patients with acute myocardial infarction: open stenting of coronary vessels, transcutaneous stenting of coronary vessels, transcutaneous coronary rotational atherectomies. The information base of the study was composed by electronic medical records that were created by doctors when providing medical care under the packages of the medical guarantee program according to the data of electronic health care system

Table 1. Data on patients with acute myocardial infarction, treated in hospitals and experienced cardiovascular interventions, 2021-2023

Area	2021				2022				2023			
	Number of treated patients with acute myocardial infarction	Open stenting of coronary vessels	Percutaneous stenting of coronary vessels	Percutaneous transluminal coronary rotational atherectomies [PTCRA]	Number of treated patients with acute myocardial infarction	Open stenting of coronary vessels	Percutaneous stenting of coronary vessels	Percutaneous transluminal coronary rotational atherectomies [PTCRA]	Number of treated patients with acute myocardial infarction	Open stenting of coronary vessels	Percutaneous stenting of coronary vessels	Percutaneous transluminal coronary rotational atherectomies [PTCRA]
Regions(Oblasts)												
Vinnytsia	1163	5	611	-	1306	2	781	1	1409	-	898	-
Volyn	900	3	434	1	972	1	583	4	1004	4	498	25
Dnipropetrovsk	3945	4	1084	3	4363	-	1566	1	4424	-	2023	116
Donetsk	1741	2	645	1	770	-	133	-	575	-	5	-
Zhytomyr	880	2	302	-	1156	1	558	-	1232	-	734	3
Transcarpathian	824	2	489	-	1017	1	644	-	1100	3	676	2
Zaporizhzhia	2002	3	842	-	1498	-	795	24	1801	-	960	60
Ivano-Frankivsk	1024	1	461	-	1261	7	708	-	1286	9	849	11
Kyiv	1411	1	452	4	1400	4	457	21	2396	4	985	91
Kirovohrad	962	8	278	2	1046	1	370	-	1077	-	542	29
Luhansk	673	-	11	-	130	-	-	-	-	-	-	-
Lviv	2812	5	1049	3	3250	19	1564	3	3557	10	1736	20
Mykolaiv	843	2	306	3	949	-	330	-	1074	-	504	11
Odesa	1578	9	835	19	2213	4	1190	14	2430	6	1403	56
Poltava	1371	6	782	2	1690	4	1012	-	1815	4	1142	31
Rivne	934	-	423	-	1057	1	677	-	1107	5	745	4
Sumy	1106	-	538	-	1185	-	631	1	1081	-	587	54
Ternopil	802	-	303	-	901	2	449	1	924	6	568	4
Kharkiv	2665	14	1017	1	2178	3	501	-	3025	3	1213	19
Kherson	826	7	200	-	411	5	91	-	291	-	121	-
Khmelnytskyi	1175	1	551	-	1300	4	780	-	1514	-	961	68
Cherkasy	1261	-	689	1	1420	-	788	-	1413	1	927	6
Chernivtsi	980	-	373	-	1088	-	579	-	1430	-	727	143
Chernihiv	896	-	376	-	809	-	392	-	968	-	558	27
City of Kyiv	2460	4	790	3	3118	5	1421	7	3243	1	1626	132
Total	32774	75	13051	40	33370	59	15579	70	36933	55	19362	780

Table 2. The level of use of cardiovascular interventions in the treatment of patients with acute myocardial infarction, 2021-2023

Area	2021			2022			2023		
	Number of treated patients with acute myocardial infarction	Number of performed cardiovascular interventions	Percentage of use of cardiovascular interventions, %	Number of treated patients with acute myocardial infarction	Number of performed cardiovascular interventions	Percentage of use of cardiovascular interventions, %	Number of treated patients with acute myocardial infarction	Number of performed cardiovascular interventions	Percentage of use of cardiovascular interventions, %
Regions(Oblasts)									
Vinnytsia	1163	616	59,96	1306	784	60,03	1409	898	70,19
Volyn	900	438	48,87	972	588	60,49	1004	527	52,49
Dnipropetrovsk	3945	1091	27,66	4363	1567	35,92	4424	2139	48,35
Donetsk	1741	648	37,22	770	133	17,27	575	5	0,87
Zhytomyr	880	304	34,55	1156	559	48,36	1232	737	59,82
Transcarpathian	824	491	59,59	1017	645	63,42	1100	682	62,00
Zaporizhzhia	2002	845	42,21	1498	819	54,67	1801	1020	56,64
Ivano-Frankivsk	1024	462	45,12	1261	715	56,70	1286	869	67,57
Kyiv	1411	457	32,39	1400	482	34,43	2396	1076	44,91
Kirovohrad	962	288	29,94	1046	371	35,47	1077	571	53,02
Luhansk	673	11	1,63	130	-	-	-	-	-
Lviv	2812	1057	37,59	3250	1578	48,55	3557	1766	49,65
Mykolaiv	843	311	36,89	949	330	34,77	1074	515	47,95
Odesa	1578	863	54,69	2213	1208	54,59	2430	1465	60,29
Poltava	1371	790	57,62	1690	1016	60,12	1815	1177	64,85
Rivne	934	423	45,29	1057	678	64,14	1107	754	68,11
Sumy	1106	538	48,64	1185	632	53,33	1081	641	59,29
Ternopil	802	303	37,78	901	452	50,17	924	578	62,55
Kharkiv	2665	1032	38,72	2178	504	23,14	3025	1235	40,83
Kherson	826	207	25,01	411	96	23,36	291	121	41,58
Khmelnytskyi	1175	552	46,98	1300	784	60,31	1514	1029	67,97
Cherkasy	1261	690	54,72	1420	788	55,49	1413	934	66,10
Chernivtsi	980	373	38,01	1088	579	53,22	1430	870	60,84
Chernihiv	896	376	41,96	809	392	48,45	968	585	60,43
City of Kyiv	2460	797	32,40	3118	1433	45,96	3243	1759	54,24
Total	**32774**	13166	40,17	**33370**	**15708**	47,07	**36933**	20197	54,69

on the number of treated patients with acute myocardial infarction and patients who underwent cardiovascular interventions for the period 2021-2023 in the regional aspect. The study covers the territories that are controlled by Ukraine during the war against Russian military aggression. *Research methods:* bibliosemantic, medico-statistical (calculation of relative values of the use of cardiovascular interventions in the treatment of patients with acute myocardial infarction), of structural-and-logical analysis.

REVIEW AND DISCUSSION

At the first stage of the study, statistical data were grouped and analyzed across the regions of Ukraine for the period 2021-2023 regarding the quantity of: treated patients for acute myocardial infarction, open coronary stenting, percutaneous coronary stenting, percutaneous transluminal coronary rotational atherectomy [PTCRA]. The obtained results are shown in Table 1.

The analysis of the data presented in Table 1 indicates that the number of acute myocardial infarction patients treated in the country's hospitals during the study period increased by 1.13 times and amounted to 36,933 patients in 2023. At the same time, an increase in the number of hospitalized patients with acute myocardial infarction was registered in 20 (80.0%) regions.

The largest quantiry of these patients was registered in Dnipropetrovsk (4,424), Lviv (3,557), and Kharkiv (3,025) regions and in the city of Kyiv (3,243).

In general, the following dynamics of the use of cardiovascular interventions were registered:

- open stenting of coronary vessels: the number decreased by 1.36 times and amounted to 55 interventions with the largest number being 10 (18.2% of the total number in Lviv region). In 2023, these coronary artery stenting technologies were used in health care institutions in 12 (48.0%) regions of Ukraine;

- percutaneous stenting of coronary vessels: the number increased by 1.48 times and in 2023 amounted to 19,362 interventions. These coronary artery stenting technologies were used in health care facilities in all regions of Ukraine in 2023. The largest number of percutaneous stentings of coronary vessels was performed in Dnipropetrovsk (2023), Lviv (1736) and Odesa (1403) regions and in the city of Kyiv (1626).

- percutaneous transluminal coronary rotational atherectomies: the number increased by 19.5 times and in 2023 amounted to 780 interventions. In 2023, these coronary artery stenting technologies were used in health care facilities in all regions of Ukraine except Vinnytsia, Donetsk, Luhansk, and Kherson regions.

Further, in order to reveal the level of use of cardiovascular interventions in the treatment of patients with acute myocardial infarction, the obtained data were summarized in a general table and the proportion of patients with acute myocardial infarction who underwent cardiovascular interventions was calculated. The obtained results are presented in Table 2.

The analysis of the data presented in Table 2 indicates that, as a whole, the share of acute myocardial infarction patients in Ukraine who were treated with cardiovascular interventions increased by 14.52% and in 2023 amounted to 54.69%.

The analysis of the use of cardiovascular interventions in the treatment of acute myocardial infarction in the dynamics of the research years showed the following:

- 2021: cardiovascular interventions were used in the treatment of 40.17% of patients with acute myocardial infarction. The largest share of acute myocardial infarction patients treated with cardiovascular interventions was registered in Vinnytsia (59.96%), Transcarpathian (59.59%) and Poltava (57.62%) regions. The smallest share was registered in Luhansk (1.63%), Kherson (25.01%), Dnipropetrovsk (27.66%) regions. In Kyiv, cardiovascular interventions in the treatment of acute myocardial infarction were used in 32.40% of cases;

- 2022: cardiovascular interventions were used in the treatment of 47.07% of patients with acute myocardial infarction. The largest share of acute myocardial infarction patients treated with cardiovascular interventions was registered in Rivne (64.14%), Transcarpathian (63.42%) and Volyn (60.49%) regions. The smallest share was registered in Donetsk (17.27%), Kharkiv (23.14%) and Kherson (23.36%) regions. This technology was not used in Luhansk region. In Kyiv, cardiovascular interventions in the treatment of acute myocardial infarction were used in 45.96% of cases;

- 2023: cardiovascular interventions were used in the treatment of 54.69% of patients with acute myocardial infarction. The largest share of acute myocardial infarction patients treated with cardiovascular interventions was registered in Vinnytsia (70.19%), Rivne (68.11%) and Khmelnytskyi (67.97%) regions. The smallest share was registered in Donetsk (0.87%), Kharkiv (40.83%) and Kherson (41.58%) regions. This technology was not used in Luhansk region. In Kyiv, cardiovascular interventions in the treatment of acute myocardial infarction were used in 54.24% of cases.

The analysis of the impact of the war against Russian military aggression on the frequency of cardiovascular interventions in the treatment of acute myocardial infarction in the regions of Ukraine showed the following:

- *regions of the zone of active hostilities:* Kharkiv region – the number of hospitalized patients with acute myocardial infarction increased by 13.51%, and the level of use of cardiovascular interventions increased

by 2.11%; Sumy region – the number of hospitalized patients with acute myocardial infarction decreased by 2.26%, and the level of use of cardiovascular interventions increased by 1.65%; Zaporizhzhia region – the number of hospitalized patients with acute myocardial infarction decreased by 14.43%, and the level of use of cardiovascular interventions increased by 10.4%; Kherson region – the number of hospitalized patients with acute myocardial infarction decreased by 64.77%, and the level of use of cardiovascular interventions increased by 16.57%;

- *regions close to the zone of active hostilities:* Dnipropetrovsk region – the number of hospitalized patients with acute myocardial infarction increased by 12.14%, and the level of use of cardiovascular interventions increased by 20.69%; Mykolaiv region – the number of hospitalized patients with acute myocardial infarction increased by 27.40%, and the level of use of cardiovascular interventions increased by 11.06%; Odesa region – the number of hospitalized patients with acute myocardial infarction increased by 53.99%, and the level of use of cardiovascular interventions increased by 5.6%; Poltava region – the number of hospitalized patients with acute myocardial infarction increased by 32.39%, and the level of use of cardiovascular interventions increased by 7.23%.

At the time of conducting this analysis, Donetsk and Luhansk regions have a special status, part of their territory has been temporarily occupied since 2014. Since then, the infrastructure of the health care system has been partially destroyed or is located in the territory that is not controlled by Ukraine. Corresponding to the above noted, data from the territories of these regions controlled by Ukraine were subject to analysis.

Donetsk region: the number of patients treated in hospitals for acute myocardial infarction decreased by 3.03 times over the years of the study and amounted to 575 patients; the share of patients who underwent cardiovascular interventions during the treatment process decreased from 37.22% to 0.87%.

Luhansk region: the number of patients with acute myocardial infarction treated in hospitals in the territories subordinated to Ukraine in 2021 amounted to 673, with the use of cardiovascular interventions at the level of 1.63%. In 2022, 130 patients were treated for acute myocardial infarction without the use of cardiovascular interventions. In 2023, patients with acute myocardial infarction in health care facilities in the territories subordinated to Ukraine were not treated on an inpatient basis.

The war against Russian military aggression caused a significant part of the population from the regions of active hostilities and territories close to them to become forced migrants within the country and refugees in other countries. Currently, there is no statistical information on their incidence of acute myocardial infarction.

The use of cardiovascular interventions during the treatment of patients with acute myocardial infarction contributes to increasing the effectiveness of treatment results and reducing patient mortality. With an increase over the years of the study of the proportion of patients with acute myocardial infarction treated with cardiovascular interventions by 14.52% with a level in 2023 of 54.69%, the use of this technology in Ukraine in comparison with European countries [6,7] and the USA [8,9] is insufficient in terms of providing them to patients with myocardial infarction.

So, in Europe and the USA, cardiovascular interventions are performed not only in patients with acute myocardial infarction, but also in 20–30% of patients with coronary heart disease [10]. It is important to compare the use of cardiovascular interventions in Ukraine and other European countries to calculate the number of interventions per 100,000 population. The comparison of the Ukrainian indicator with the "average European" one was first published by the representative of the European Society of Cardiology, Professor P. Widimsky [11]. In 2013, the number of primary stenting in patients with acute myocardial infarction in Ukraine was at the level of 75 patients per 1 million population, which was almost 5 times less than the average European indicator [12].

Subsequently, an increase in the indicator was registered: 2014 – 100 patients per 1 million population [13], 2015 – 132 [14], 2016 – 190 [15], 2017 – 220 [16], 2018 – 286, 2019 – 312, 2020 – 336, 2021 – 391, 2022 – 442 with the European average indicator of 373 [17].

Scientific publications indicate a decrease in the availability and quality of medical care during the war [18,19]. Our study found a significant decrease in the use of cardiovascular interventions during the treatment of patients with acute myocardial infarction in Donetsk and Luhansk regions.

CONCLUSIONS

In Ukraine, an increase is detected in the level of the use of cardiovascular interventions in the treatment of patients with acute myocardial infarction for the period from 2021 to 2023 by 14.52% with a level of use in 2023 of 54.69%. Reliable differences in the level of use of cardiovascular interventions in the treatment of patients with acute myocardial infarction across the regions of Ukraine were revealed. A critically low level of the use of these technologies is observed in the territory of Donetsk and Luhansk regions controlled by Ukraine, a part of which have been temporarily occupied by Russian troops since 2014.

REFERENCES

1. Fuster V, Kelly BB et al. Institute of Medicine (US) Committee on Preventing the Global Epidemic of Cardiovascular Disease: Meeting the Challenges in Developing Countries. Promoting Cardiovascular Health in the Developing World: A Critical Challenge to Achieve Global Health. Washington (DC): National Academies Press (US). 2010. doi: 10.17226/12815. DOI
2. Terenda NO, Shulhai AH, Petrashyk YM et al. Impact of certain public health factors on the duration of inpatient treatment of mi patients. Wiad Lek. 2020;73(5):850–856.
3. Slabkyi HO, Koshelia II. Smertnist naselennia Ukrainy vnaslidok khvorob systemy krovoobihu v peredvoiennyi period. [Mortality of the population of Ukraine due to diseases of the circulatory system in the pre-war period]. Ukraina. Zdorovia natsii. 2022;4(70):5–10. (Ukrainian)
4. Park J-S, Jeong S, Lee DH. Recent Advances in Gastrointestinal Stent Development. Clin Endosc. 2015;48(3):209-15. doi: 10.5946/ce.2015.48.3.209. DOI
5. Pakety medychnykh posluh. Zmist ta pidkhid do kontraktuvannia zakladiv okhorony zdorovia. Natsionalna sluzhba zdorovia Ukrainy. [Medical service packages. Contents and guidelines for contracting health care institutions. National Health Service of Ukraine]. Kyiv, 2020, p.59. (Ukrainian)
6. Silber S, Albertsson P, Aviles FF et al. Guidelines for percutaneous coronary interventions: the task force for percutaneous coronary interventions of the European Society of Cardiology. Eur Heart J. 2005;26(8):804-47. doi: 10.1093/eurheartj/ehi138. DOI
7. Gupta M, Chang WC, Van de Werf F et al. International differences in in-hospital revascularization and outcomes following acute myocardial infarction: a multilevel analysis of patients in ASSENT-2. Eur Heart J. 2003;24(18):1640-50. doi: 10.1016/s0195-668x(03)00433-0. DOI
8. Anderson HV, Shaw RE, Brindis RG et al. A contemporary overview of percutaneous coronary interventions. The American College of Cardiology-National Cardiovascular Data Registry (ACC-NCDR). J Am Coll Cardiol. 2002;39(7):1096-103. doi: 10.1016/s0735-1097(02)01733-3. DOI
9. Vakili BA, Kaplan R, Brown DL. Volume-outcome relation for physicians and hospitals performing angioplasty for acute myocardial infarction in New York state. Circulation. 2001;104(18):2171-6. doi: 10.1161/hc3901.096668. DOI
10. Sokolov MYu. Reyestr cherezshkirnykh koronarnykh vtruchan'. Zminy na 2015–2018 rr. – vypadkovyy splesk diyal'nosti chy systemni peretvorennya? [Register of percutaneous coronary interven tions. Are changes for 2015–2018 a casual splash of activi ties or system transformations?]. Sertse i sudyny. 2019;3:12 33. (Ukrainian)
11. Widimsky P, Wijns W, Fajadet J et al. Reperfusion therapy for ST elevation acute myocardial infarction in Europe: description of the current situation in 30 countries. Eur Heart J. 2010;31(8):943-57. doi: 10.1093/eurheartj/ehp492. DOI
12. Sokolov MYu. Reyestr cherezshkirnykh koronarnykh vtruchan': rozshyrenyy porivnyal'nyy analiz 2012–2013 rr. [Percutaneous Coronary Interventions Registry: advanced comparative analysis 2012–2013]. Sertse i sudyny. 2014;3:7-20. (Ukrainian)
13. Sokolov MYu. Reyestr cherezshkirnykh koronarnykh vtruchan': rozshyrenyy porivnyal'nyy analiz, reperfuziyna terapiya v Ukrayini, Ohlyad CHKV – 2015. [Percutaneous Coronary Interventions Registry: advanced comparative analysis, reperfusion therapy in Ukraine, Survey PCI – 2015]. Sertse i sudyny. 2015;3:7 29. (Ukrainian)
14. Sokolov MYu. Reyestr cherezshkirnykh koronarnykh vtruchan': porivnyal'nyy analiz 2014–2015 rr. Dynamika rehional'nykh reperfuziynykh merezh v Ukrayini. [Percutaneous Coronary Interventions Registry: comparative analysis of 2014–2015 years. The dynamics of regional reperfusion networks in Ukraine]. Sertse i sudyny. 2016;3:14 34. (Ukrainian)
15. Sokolov MYu. Reyestr cherezshkirnykh koronarnykh vtruchan': rozshyrenyy porivnyal'nyy analiz rezul'tativ 2016 ta 20 17 rr. Vid reperfuziynoho paradoksu do znyzhennya smertnosti. [Register of percutaneous coronary interven tions: expanded comparative analysis of results of 2016 and 20 17. From reperfusion paradox to decrease of mortality]. Sertse i sudyny. 2018;3:9 27. (Ukrainian)
16. Sokolov MYu. Reyestr cherezshkirnykh koronarnykh vtruchan': rozshyrenyy porivnyal'nyy analiz, reperfuziyna terapiya v Ukrayini, Ohlyad CHKV – 2015. [Percutaneous Coronary Interventions Registry: advanced comparative analysis, reperfusion therapy in Ukraine, Survey PCI – 2015]. Sertse i sudyny. 2015;3:7 29. (Ukrainian)
17. Sokolov MYu, Danylchuk IV, Besh DI et al. Reyestr cherezshkirnykh koronarnykh vtruchan': zminy za ostanni roky (2010–2022 rr.). [Registry of percutaneous coronary interventions: changes over recent years (2010–2022)]. Ukrainian Journal of Cardiology 2024;1:7-33. doi: 10.31928/2664-4479-2024.1.733. (Ukrainian) DOI
18. Maksimovich MI, Litvin NA. Current challenges of access to healthcare during the war. Juridical scientific and electronic journal. 2022;9:330-332. doi:10.32782/2524-0374/2022-9/80. DOI
19. Health care during the war: The impact of Russia's full-scale invasion on health care in Ukraine.». International Renaissance Foundation. Agency for Legislative Initiatives.Ukrainian Medical Center. 2023, p.26.

CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR
Gennadiy O. Slabkiy
Uzhhorod National University
14 University St, 88000 Uzhhorod, Ukraine
e-mail: g.slabkiy@ukr.net

ORCID AND CONTRIBUTIONSHIP
Gennadiy O. Slabkiy: 0000-0003-2308-7869 A C
Victoria J. Bilak-Lukyanchuk: 0000-0003-3020-316X B C
Rostislav L. Kartavtsev: 0000-0002-2634-0017 B C D E
Vitalii Kondratskyi: 0000-0002-2413-0198 D E
Svitlana Dudnik: 0000-0002-7012-424X F

A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval of the article

RECEIVED: 10.12.2024
ACCEPTED: 23.01.2025