Dyslipidemia treatment and attainment of LDL-cholesterol treatment goals in patients participating in the Managed Care for Acute Myocardial Infarction Survivors program

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ABSTRACT

Background: Patients after acute myocardial infarction (AMI) are at very high cardiovascular (CV) risk. Therefore, appropriate management of dyslipidemia with adequate lipid-lowering therapy is crucial for preventing subsequent CV events in these patients.

Aims: Our analysis aimed to assess the treatment of dyslipidemia and attainment of low-density lipoprotein cholesterol (LDL-C) treatment goals in patients after AMI who participated in the Managed Care for Acute Myocardial Infarction Survivors (MACAMIS) program.

Methods: This study is a retrospective analysis of consecutive patients with AMI who agreed to participate and completed the 12-month MACAMIS program at one of three tertiary referral cardiovascular centers in Poland between October 2017 and January 2021.

Results: 1499 patients after AMI were enrolled in the study. High-intensity statin therapy was prescribed for 85.5% of analyzed patients on hospital discharge. Combined therapy with high-intensity statin and ezetimibe increased from 2.1% on hospital discharge to 18.2% after 12 months. In the whole study cohort, 20.4% of patients achieved the LDL-C target of <55 mg/dl (<1.4 mmol/l), and 26.9% of patients achieved at least a 50% reduction in LDL-C level one year after AMI.

Conclusions: Our analysis suggests that participation in the managed care program might be associated with improved quality of dyslipidemia management in AMI patients. Nonetheless, only one-fifth of patients who completed the program achieved the treatment goal for LDL-C. This highlights the constant need for optimizing lipid-lowering therapy to meet treatment targets and reduce CV risk in patients after AMI.

Key words: cardiovascular risk, lipid-lowering therapy; low-density lipoprotein cholesterol, myocardial infarction, secondary prevention

WHAT'S NEW?

Improved prognosis in patients participating in the 12-month, nationwide Managed Care for Acute Myocardial Infarction Survivors (MACAMIS; "KOS-Zawał") program has been previously demonstrated. In this study, we aimed to assess the management of dyslipidemia and achievement of low-density lipoprotein cholesterol (LDL-C) therapeutic goals in patients participating in the MACAMIS program at one of three large tertiary cardiovascular centers. In this cohort, high-intensity statin therapy was prescribed for 85.5% of patients on hospital discharge, but only 20.4% of patients achieved the LDL-C target of <55 mg/dl (<1.4 mmol/l) at 12 months. There is a continuing need to optimize lipid-lowering therapy to achieve therapeutic goals and reduce cardiovascular risk.

INTRODUCTION

A decrease in low-density lipoprotein cholesterol (LDL-C) level by one mmol/l with statin therapy reduces the 5-year incidence of major coronary events, coronary revascularization, and stroke by about one-fifth [1]. Adding ezetimibe to statin therapy lowers LDL-C level and may further reduce the rate of cardiovascular events [2]. The reduction in atherosclerotic cardiovascular disease (ASCVD) risk is directly and positively correlated with the achieved absolute LDL-C reduction, irrespective of baseline cholesterol concentration [3]. Clinical trials on the anti-proprotein convertase subtilisin/kexin type 9 (PCSK9) monoclonal antibodies added to statin therapy showed that the lower the LDL-C values achieved, the lower the risk of future cardiovascular events, with no lower limit for LDL-C values [4]. Additionally, recent data suggest that the current approach to LDL-C reduction in high-risk patients should not only focus on maintaining low LDL-C level but also on the early achievement of LDL-C treatment goals [5, 6]. The reduction in major vascular events by lowering the LDL-C level is most significant in patients in the highest cardiovascular disease risk categories [7]. Patients after myocardial infarction are at very high risk of recurrent ASCVD events. Due to the large heterogeneity of this population, it is suggested that some of them should be identified as individuals at extremely high cardiovascular risk who could benefit from lowering the LDL-C level most significantly [8, 9]. Therefore, appropriate management of dyslipidemias with the use of adequate lipid-lowering therapy is crucial to efficiently reduce cardiovascular risk after acute coronary syndrome (ACS). At the same time, real-world data clearly show that only 18% of the very high-risk patients achieve the LDL-C treatment target and even fewer in the population of high-risk patients in Central and Eastern European countries [10, 11].

The Managed Care for Acute Myocardial Infarction Survivors (MACAMIS; "KOS-Zawał") program was implemented to improve the quality of medical care during the first 12 months after myocardial infarction, which is considered the most vulnerable time after ACS with exceptionally high risk of recurrent cardiovascular (CV) events. In brief, the program includes treatment of acute myocardial infarction (AMI), cardiac rehabilitation, prevention of sudden cardiac death, and prescheduled cardiology outpatient visits for one year following AMI [12, 13]. The comparison of outcomes of patients after AMI participating and not participating in the MACAMIS program showed that managed care after myocardial infarction was associated with improved prognosis. However, the reasons for the potential advantage of this program, especially in terms of secondary prevention, including lipid-lowering therapy, have not been sufficiently explored [14].

Our analysis aimed to assess the treatment of dyslipidemia and attainment of LDL-C treatment goals in patients participating in the MACAMIS program.

METHODS

We included in the study all consecutive adult patients who had been admitted to one of three tertiary referral centers in Southern Poland (Silesian Center for Heart Diseases in Zabrze, Leszek Giec Upper-Silesian Medical Center in Katowice, and Jagiellonian University Medical College, Institute of Cardiology, Department of Interventional Cardiology in Kraków). They were hospitalized for AMI between October 2017 and January 2021 and agreed to participate in the MACAMIS program and completed the program (attended all outpatient cardiology visits). The MACAMIS program consists of four treatment modules: the treatment of the acute phase of myocardial infarction (including coronary angiography, percutaneous coronary intervention, coronary artery bypass grafting or conservative treatment, and a follow-up visit within 14 days after discharge), cardiac rehabilitation, electrotherapy (i.e., implantation of cardiac implantable electronic devices, including implantable cardioverter-defibrillator), and specialized ambulatory cardiac care for 12 months (at least 3 visits) following AMI, including laboratory tests [12, 13].

The data on the baseline characteristics, the baseline lipid profile (measured during index hospitalization) and at 12 months, cholesterol-lowering treatment on hospital discharge, and all ambulatory cardiology visits during the 12-month program were extracted from the hospital and ambulatory medical records. The approval of a bioethics committee was not required for this study, considering that it was a retrospective analysis of an anonymized dataset.

The cholesterol-lowering treatment during the MACAMIS program and after 12 months was defined as medications prescribed on the second last and the last

ambulatory cardiology visits. High-intensity statin therapy included a prescription fill for atorvastatin 40–80 mg daily or rosuvastatin 20–40 mg daily. Maximal statin therapy was defined as atorvastatin 80 mg daily and rosuvastatin 40 mg daily.

Statistical analysis

Categorical variables were shown as absolute and relative frequencies (percentages). The normality of continuous variables distribution was assessed by the Shapiro-Wilk test. Quantitative variables were not normally distributed and are, therefore, presented as median (interquartile range [IQR]). The ordinal or continuous variables, measured repeatedly over time, were compared using Friedman and Wilcoxon signed-rank tests. *P*-value <0.05 was considered significant. All reported *P*-values are two-sided. The statistical analyses were performed using Statistica version 13.3 (TIBCO Software, Palo Alto, CA, US).

RESULTS

A total of 1499 patients who completed the 12-month MACAMIS program were enrolled in the study (median age of 65 [57–71] years, 71.5% males). The presentation of AMI was ST-segment elevation myocardial infarction (STEMI) in 43% and non-ST-segment elevation myocardial infarction (NSTEMI) in 57% of patients. More details on the baseline clinical characteristics of patients are presented in Table 1.

The data on the lipid profile were available for 1421 (94.8%) patients at baseline (median LDL-C level of 115.0 [82.0–150.0] mg/dl) and 1354 (90.3%) patients at 12 months (median LDL-C level of 75.0 [58.2–98.0] mg/dl). The lipid profile at baseline and at the end of the MACAMIS program are presented in Table 2. The median change in LDL-C level between the index hospitalization and the last ambulatory visit in the subgroups of patients stratified by cholesterol-lowering therapy was most remarkable in patients on combination therapy with high-intensity statin and ezetimibe (n = 65, a median absolute difference of LDL-C level –53 mg/dl [–1.4 mmol/l]; median relative change in LDL-C level –41.7%), as presented in Table 3.

The comparison of cholesterol-lowering therapy prescribed on hospital discharge, during the 12-month managed care program (on the second last ambulatory visit), and on the last ambulatory visit (at 12 months) is presented in Figure 1. High-intensity statin therapy (atorvastatin 40–80 mg daily or rosuvastatin 20–40 mg daily) was prescribed on hospital discharge to 85.5% of analyzed patients (including 2.1% on high-intensity statin with ezetimibe combination therapy). On the last ambulatory visit, high-intensity statin therapy was prescribed to 80% of patients (including 18.2% on high-intensity statins combined with ezetimibe).

In the whole study cohort, 20.4% of patients achieved the LDL-C target of <55 mg/dl (<1.4 mmol/l), and 26.9% of patients attained at least a 50% reduction from the baseline LDL-C level. In the analysis of subgroups of patients stratified by cholesterol-lowering therapy, the LDL-C target of <55 mg/dl (<1.4 mmol/l) was achieved by 20.9% of patients on high-intensity statin therapy and 28.4% of patients on combination therapy with high-intensity statin and ezetimibe. In addition, the 50% LDL-C reduction was attained by 28.7% of patients on high-intensity statin therapy and 41.5% of patients on high-intensity statin and ezetimibe combination therapy (Figure 2).

The analysis of changes in the statin therapy during the12-month managed care program showed that in 69.4% of patients, lipid-lowering therapy was maintained, in 10.1% was deescalated, and in 20.5% intensified on hospital discharge (Figure 3). Among patients in whom statin treatment was withdrawn during the 12-month program,

Table 1. Baseline clinical characteristics of patients after AMI who completed the 12-month managed care program

Characteristics	All patients (n = 1499)
Sex, male, n (%)	1072 (71.5)
Age, years, median (IQR)	65 (57–71)
Hypertension, n (%)	1015 (67.7)
Diabetes mellitus, n (%)	397 (26.5)
Smoking status	
Current smoker, n (%)	377 (25.2)
Former smoker, n (%)	192 (12.8)
Previous MI, n (%)	335 (22.3)
Previous PCI, n (%)	349 (23.3)
Previous CABG, n (%)	97 (6.5)
Previous stroke, n (%)	57 (3.8)
PAD, n (%)	113 (7.5)
AMI presentation	
STEMI, n (%)	645 (43.0)
NSTEMI, n (%)	854 (57.0)
PCI, n (%)	1377 (91.9)
CABG, n (%)	64 (4.3)
Time from admission for AMI to last ambulatory visit, days, median (IQR)	338 (333–350)

Abbreviations: AMI, acute myocardial infarction; CABG, coronary artery bypass grafting; NSTEMI, non-ST-segment elevation myocardial infarction; PCI, percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction; PAD, peripheral artery disease

Table 2. Lipid profile at baseline and at 12 months

Lipid profile	At baseline	At 12 months	*P*-value
TC, mg/dl, median (IQR)	190.0 (155.0–228.0)	141.0 (121.0–165.0)	<0.01
LDL-C, mg/dl, median IQR)	115.0 (82.0–150.0)	75.0 (58.2–98.0)	<0.01
Non-HDL-C, mg/dl, median (IQR)	133.0 (101.0–196.0)	91 (73.0–115.0)	<0.01
HDL-C, mg/dl, median (IQR)	45.0 (37.5–56.0)	47.0 (41.0–57.0)	<0.01
Triglycerides, mg/dl, median (IQR)	116.0 (82.0–173.3)	113.0 (86.0–159.0)	0.37

Abbreviations: HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; TC, total cholesterol

Table 3. LDL-C levels at baseline and after 12 months in the whole study cohort and subgroups of patients stratified by cholesterol-lowering therapy

Cholesterol-lowering treatment during managed care program	LDL-C level (mg/dl) at baseline, median (IQR)	LDL-C level (mg/dl) at 12 months, median (IQR)	Median absolute difference of LDL-C level, mg/dl	Median relative change in LDL-C level, %
All patients (n = 1290)	115.0 (82.0–150.0)	75.0 (58.2–98.0)	–34.0	–32.0
No treatment (n = 20)	92.3 (64.5–122.3)	102.1 (65.5–138.0)	14.0	13.3
Ezetimibe (n = 8)	104.3 (97.1–125.8)	120.4 (87.5–137.1)	–5.4	–5.2
Low- to moderate-dose statins (n = 207)	90.0 (66.0–130.0)	76.0 (59.4–97.0)	–10.0	–12.0
Low- to moderate-dose statins + ezetimibe (n = 12)	123.0 (65.4–187.0)	92.7 (66.5–141.2)	–12.5	–6.4
High-intensity statins (n = 972)	118.4 (87.0–151.3)	75.0 (58.0–97.0)	–40.0	–35.4
Atorvastatin 40/60 mg (n = 409)	116.0 (83.1–148.0)	78 (63.4–100.0)	–31.0	–31.0
Atorvastatin 80 mg (n = 297)	123.7 (93.2–159.7)	75.4 (59.2–99.0)	–46.0	–37.8
Rosuvastatin 20/30 mg (n = 152)	108.5 (81.5–143.3)	67.9 (51.0–87.0)	–36.1	–37.3
Rosuvastatin 40mg (n = 114)	127.4 (88.0–158.0)	67.3 (52.0–92.0)	–49.5	–40.6
High-intensity statins + ezetimibe (n = 65)	136.0 (104.4–167.8)	67.7 (51.0–100.0)	–53.0	–41.7
Atorvastatin 40/60 mg + ezetimibe (n = 16)	128.0 (104.0–189.7)	66.2 (47.0–111.3)	–67.7	–49.8
Atorvastatin 80 mg + ezetimibe (n = 21)	141.5 (105.6–166.3)	74.6 (55.7– 104.0)	–50.2	–38.7
Rosuvastatin 20/30 mg + ezetimibe (n = 20)	132.7 (102.7–159.5)	71.1 (46.3–89.9)	–52.4	–40.0
Rosuvastatin 40 mg + ezetimibe (n = 8)	136.7 (97.9–182.9)	66.5 (36.4–92.9)	–69.8	–49.0

Abbreviations: IQR, interquartile range; other — see Table 2

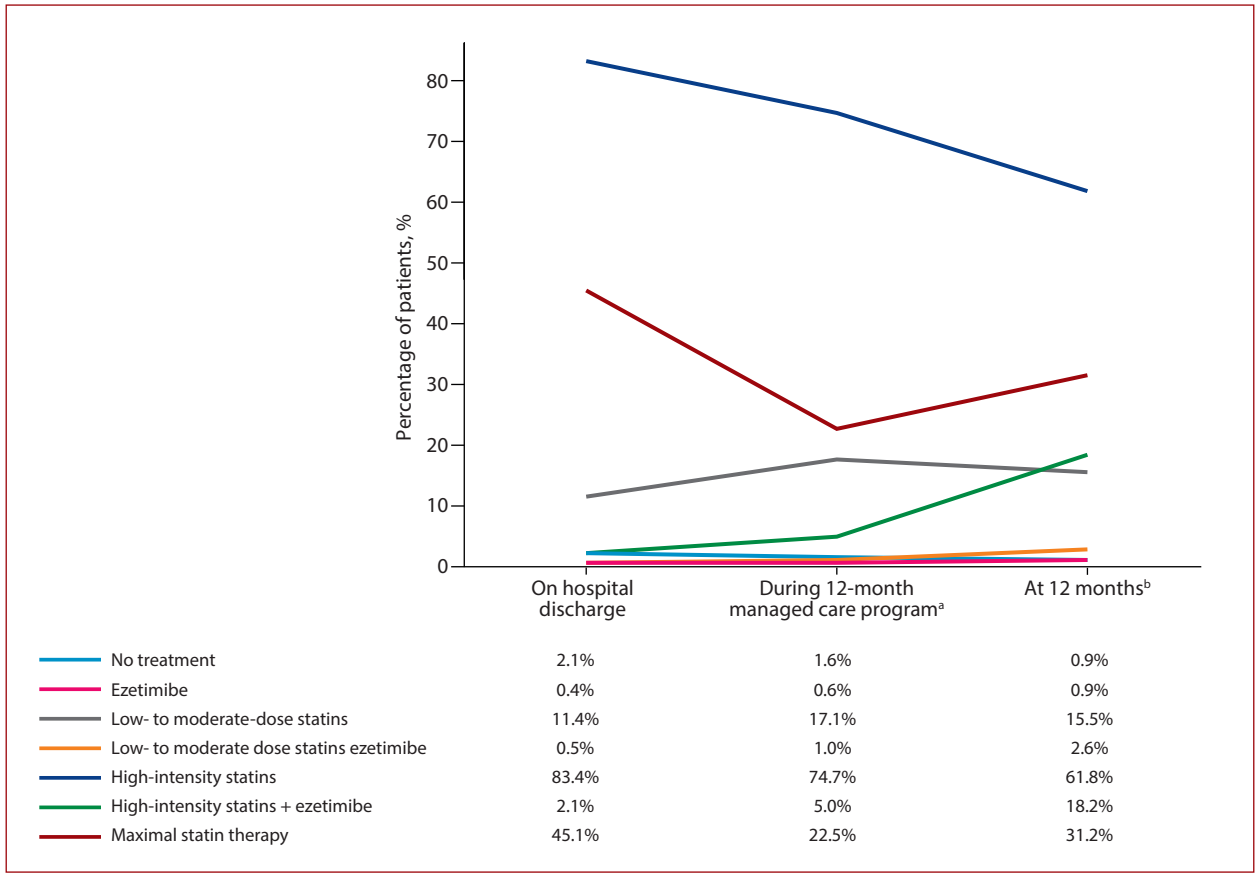

Figure 1. Comparison of cholesterol-lowering therapy prescribed on hospital discharge, during the 12-month managed care program, and on the last ambulatory visit (at 12 months)

[a]*P*-value <0.001 for comparison of treatment on discharge vs. during managed care program
[b]*P*-value <0.001 for comparison of treatment during managed care program vs. after 12 months

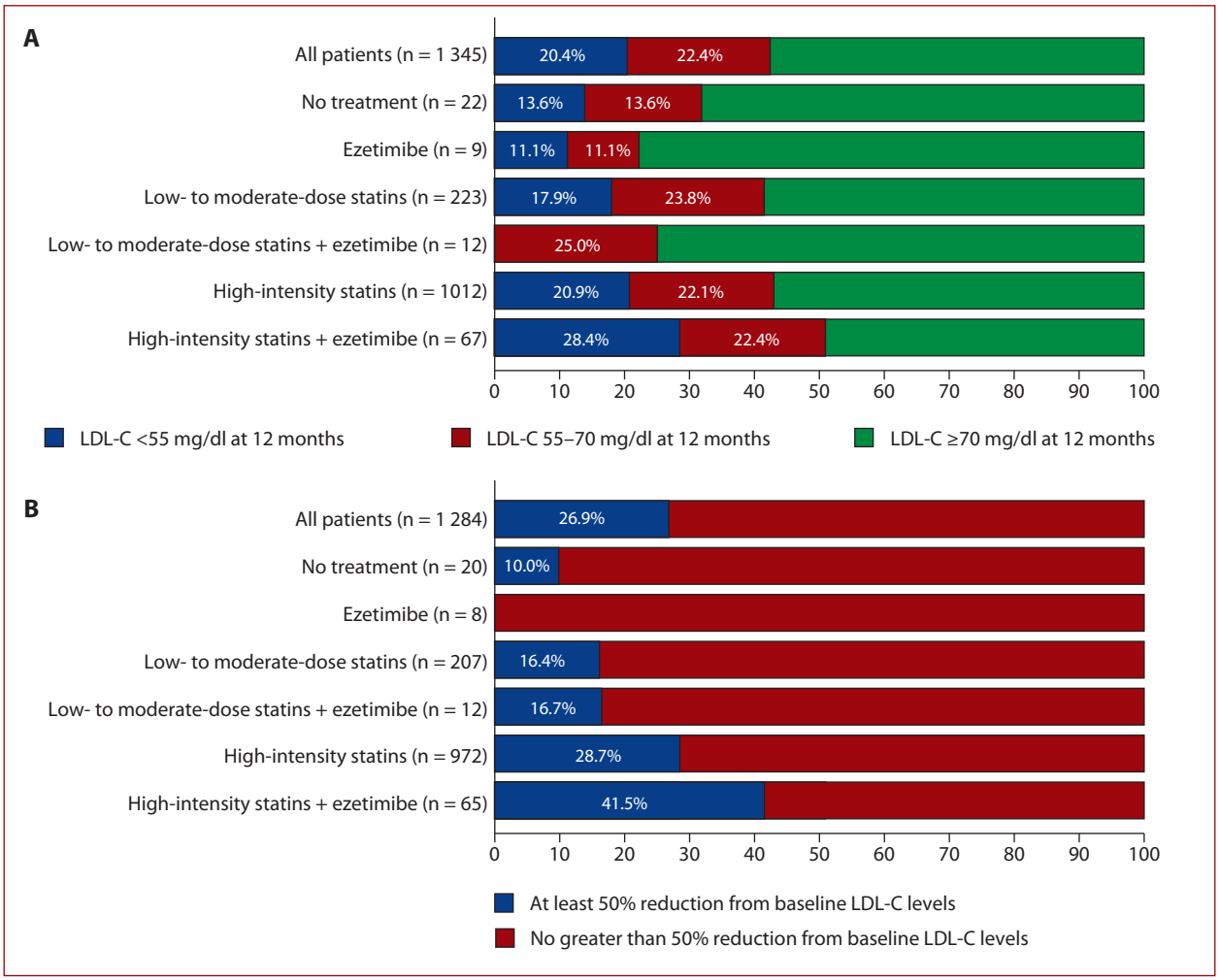

Figure 2. Percentage of patients achieving low-density lipoprotein cholesterol (LDL-C) targets at 12 months in the whole study cohort and subgroups of patients stratified by cholesterol-lowering therapy. **A.** LDL-C targets are defined as LDL-C <55 mg/dl and between 55 and 70 mg/dl. **B.** At least a 50% reduction from the baseline LDL-C level

Abbreviations: see Table 2

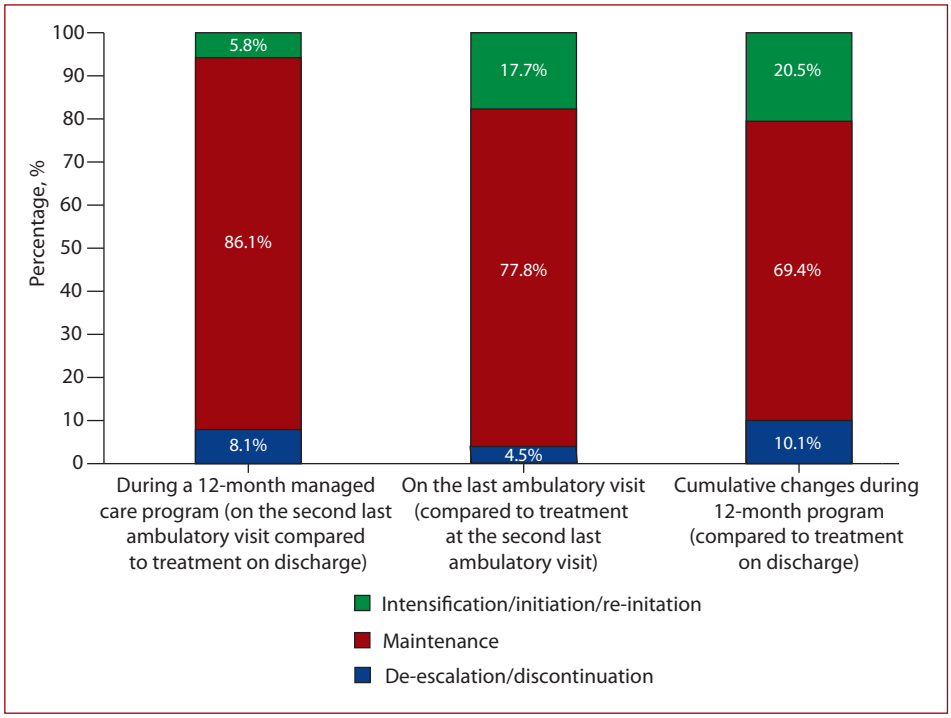

Figure 3. Changes in the lipid-lowering therapy during the 12-month managed care program

the most common reason for discontinuation was patients' reluctance to continue therapy (70.3%), followed by muscle pain (18.9%) and elevated liver enzymes (5.4%).

DISCUSSION

Patients after ACS are at very high risk of recurrent CV events. This fact was recognized by the recent 2019 European Society of Cardiology (ESC) and European Atherosclerosis Society (EAS) Guidelines for the management of dyslipidemias which included this group of patients in the very-high CV risk category, requiring more stringent LDL-C goals than other patients [15].

Our study encompassed 1499 patients with AMI who completed the 12-month, nationwide MACAMIS program. In this cohort, only 20.4% of patients achieved the LDL-C target of <55 mg/dl (<1.4 mmol/l), which is the recommended goal in the very-high CV risk group of patients according to the 2019 ESC/EAS dyslipidemia guidelines [15]. In the subgroups of patients stratified by the type of cholesterol-lowering therapy, the LDL-C target of <55 mg/dl (<1.4 mmol/l) was achieved by 20.9% of patients on high-intensity statin therapy and 28.4% of patients on high-intensity statin with ezetimibe combination therapy.

In contrast, in the international DA VINCI study conducted in 18 European countries, 18% of the secondary prevention patients achieved the LDL-C goal of <55 mg/dl (<1.4 mmol/l); 22% of patients on high-intensity statin therapy and 21% of patients using ezetimibe in combination with statins attained the LDL-C goal of <55 mg/dl (<1.4 mmol/l), respectively [10]. Moreover, in the DA VINCI study, in patients on PCSK9 inhibitor treatment in combination with any lipid-lowering treatment, the LDL-C goal of <55 mg/dl (<1.4 mmol/l) attainment was 58% [10]. It is worth emphasizing that since the nationwide drug program for PCSK9 inhibitors was approved in Poland in November 2020 and started in 2021, none of the patients from the MACAMIS program have been treated with PCSK9 inhibitors, neither at baseline nor during the 12-month MACAMIS program.

In recent years, the results of several studies presenting "real-world" lipid-lowering therapy in the Polish setting have been published. For example, in the analysis of consecutive patients admitted to the Department of Internal Diseases in 2019 and 2020, only 1 in 5 patients with dyslipidemia achieved the 2019 ESC/EAS guideline-recommended level of LDL-C (according to the patient's risk category) [16].

The results from the multicenter POLASPIRE survey, which included patients with acute coronary syndrome and/or undergoing myocardial revascularization in Poland, showed that only 2.3% of the study population had all of the five main risk factors well controlled (non-smoking, blood pressure <140/90 mm Hg, LDL-C <1.8 mmol/l and glucose <7.0 mmol/l, body mass index <25 kg/m^2) [17]. Contrary to our analysis, patients who participated in the POLASPIRE survey were admitted not only to teaching centers but also to municipal hospitals (which may differ in terms of the quality of secondary prevention and ambulatory care). In this study, 68.1% of patients hospitalized for ACS were prescribed a high-dose statin, which was a much lower rate than in our analysis (85.5%) [18]. However, within 12 months following discharge, statin therapy was more often up-titrated in the POLASPIRE cohort, and after one year, the rate of patients on high-statin therapy was almost the same as in the MACAMIS cohort (approximately 80%). On the other hand, ezetimibe was prescribed only in 2.6% of cases in POLASPIRE (as compared to our cohort, where 21.7% of patients were treated with ezetimibe at one year). Finally, 25% fewer patients achieved the LDL-C goal of <55 mg/dL (<1.4 mmol/l) in the POLASPIRE cohort than in the MACAMIS program.

The Hyperlipidaemia Therapy in tERtiary Cardiological cEnTer (TERCET) Registry included Polish ACS secondary-prevention patients [19]. In that analysis, 29.9% of patients with NSTEMI and 32.4% of patients with STEMI achieved the therapeutic target of LDL-C <70 mg/dl at 1 year, which was the recommended goal of LDL-C according to the 2016 ESC/EAS Guidelines and Polish Forum for Prevention Guidelines on Dyslipidaemia published the same year [20, 21]. Compared to the TERCET population, the LDL-C target of <70 mg/dl was achieved by a numerically higher percentage of patients (42.4%) who completed the 12-month MACAMIS program. Thus, the differences in the rates of patients on high-intensity lipid-lowering therapy and patients achieving treatment goals between the current study considering patients participating in the MACAMIS program and previous studies, including TERCET and POLASPIRE, might reflect improved quality of dyslipidemia management in AMI patients participating in this managed care program.

Considering the high heterogeneity of the very-high CV risk group and data from PCSK9 inhibitors trials, the extremely high CV risk category of ACS patients has been recently proposed. The extremely high CV risk category includes patients who might benefit from even more significant LDL-C reduction than the very-high-risk group. Individuals considered to be at extremely high CV risk are patients who experience a second vascular event within 2 years and patients with acute coronary syndrome and multivessel disease, polyvascular disease, familial hypercholesterolemia, or diabetes mellitus (with at least one additional risk factor) [5]. Our study shows that even less strict LDL-C treatment goals are hardly ever met in real-world patients after AMI on combination therapy with high-intensity statin and ezetimibe. It underscores the need for broader availability and applicability of PCSK9 inhibitors in secondary prevention.

Some study limitations should be acknowledged. The main limitation of our study is its observational character and lack of a control group consisting of patients who did not participate in MACAMIS, which might allow for a direct comparison of secondary prevention efficacy in this pro-

gram. Furthermore, data on the use of cholesterol-lowering treatment are based on medical recommendations and patients' declarations. Therefore, the influence of patients' noncompliance with medical recommendations on the results is a substantial study limitation. However, this aspect reflects the real-world conditions of the analysis.

CONCLUSIONS

Our study suggests that participation in the MACAMIS program might be associated with improved quality of dyslipidemia management in real-world AMI patients. Nonetheless, only one-fifth of patients who completed the program achieved the treatment goal for LDL-C. This highlights the constant need for optimizing lipid-lowering therapy to meet treatment targets and reduce cardiovascular risk in very high-risk patients after AMI.

Furthermore, this study shows that LDL-C treatment goals, even on a high-intensity statin with ezetimibe combination therapy, are rarely met in real-world patients after AMI. This fact highlights the need for broader availability and applicability of PCSK9 inhibitors in secondary prevention.

Article information

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REFERENCES

1. Baigent C, Keech A, Kearney PM, et al. Efficacy and safety of cholesterol-lowering treatment: prospective meta-analysis of data from 90,056 participants in 14 randomised trials of statins. Lancet. 2005; 366(9493): 1267–1278, doi: 10.1016/S0140-6736(05)67394-1, indexed in Pubmed: 16214597.
2. Cannon CP, Blazing MA, Giugliano RP, et al. Ezetimibe added to statin therapy after acute coronary syndromes. N Engl J Med. 2015; 372(25): 2387–2397, doi: 10.1056/NEJMoa1410489, indexed in Pubmed: 26039521.
3. Baigent C, Blackwell L, Emberson J, et al. Efficacy and safety of more intensive lowering of LDL cholesterol: a meta-analysis of data from 170,000 participants in 26 randomised trials. Lancet. 2010; 376(9753): 1670–1681, doi: 10.1016/S0140-6736(10)61350-5, indexed in Pubmed: 21067804.
4. Sabatine MS, Giugliano RP, Keech AC, et al. Evolocumab and clinical outcomes in patients with cardiovascular disease. N Engl J Med. 2017; 376(18): 1713–1722, doi: 10.1056/NEJMoa1615664, indexed in Pubmed: 28304224.
5. Banach M, Penson PE, Vrablik M, et al. Optimal use of lipid-lowering therapy after acute coronary syndromes: A Position Paper endorsed by the International Lipid Expert Panel (ILEP). Pharmacol Res. 2021; 166: 105499, doi: 10.1016/j.phrs.2021.105499, indexed in Pubmed: 33607265.
6. Ray KK, Reeskamp LF, Laufs U, et al. Combination lipid-lowering therapy as first-line strategy in very high-risk patients. Eur Heart J. 2022; 43(8): 830–833, doi: 10.1093/eurheartj/ehab718, indexed in Pubmed: 34636884.
7. Mihaylova B, Emberson J, Blackwell L, et al. The effects of lowering LDL cholesterol with statin therapy in people at low risk of vascular disease: meta-analysis of individual data from 27 randomised trials. Lancet. 2012; 380(9841): 581–590, doi: 10.1016/S0140-6736(12)60367-5, indexed in Pubmed: 22607822.
8. Gierlotka M, Zdrojewski T, Wojtyniak B, et al. Incidence, treatment, in-hospital mortality and one-year outcomes of acute myocardial infarction in Poland in 2009-2012. Nationwide AMI-PL database. Kardiol Pol. 2015; 73(3): 142–158, doi: 10.5603/KP.a2014.0213, indexed in Pubmed: 25371307.
9. Dyrbuś K, Gąsior M, Penson PE, et al. Extreme cardiovascular risk-do we need a new risk category? Eur Heart J. 2021 [Epub ahead of print]; 43(19): 1784–1786, doi: 10.1093/eurheartj/ehab771, indexed in Pubmed: 34792106.
10. Ray KK, Molemans B, Schoonen WM, et al. EU-Wide Cross-Sectional Observational Study of Lipid-Modifying Therapy Use in Secondary and Primary Care: the DA VINCI study. Eur J Prev Cardiol. 2021; 28(11): 1279–1289, doi: 10.1093/eurjpc/zwaa047, indexed in Pubmed: 33580789.
11. Vrablik M, Seifert B, Parkhomenko A, et al. Lipid-lowering therapy use in primary and secondary care in Central and Eastern Europe: DA VINCI observational study. Atherosclerosis. 2021; 334: 66–75, doi: 10.1016/j.atherosclerosis.2021.08.035, indexed in Pubmed: 34482090.
12. Jankowski P, Gąsior M, Gierlotka M, et al. Coordinated care after myocardial infarction. The statement of the Polish Cardiac Society and the Agency for Health Technology Assessment and Tariff System [in Polish]. Kardiol Pol. 2016; 74(8): 800–811, doi: 10.5603/KP.2016.0118, indexed in Pubmed: 27553352.
13. Kubielas G, Diakowska D, Uchmanowicz I. Survival analysis of patients with acute coronary syndrome receiving comprehensive coordinated care after myocardial infarction (KOS-Zawał). Kardiol Pol. 2022; 80(3): 415–321, doi: 10.33963/KP.a2022.0035, indexed in Pubmed: 35129204.
14. Jankowski P, Topór-Mądry R, Gąsior M, et al. Innovative managed care may be related to improved prognosis for acute myocardial infarction survivors. Circ Cardiovasc Qual Outcomes. 2021; 14(8): e007800, doi: 10.1161/CIRCOUTCOMES.120.007800, indexed in Pubmed: 34380330.
15. Mach F, Baigent C, Catapano AL, et al. 2019 ESC/EAS Guidelines for the management of dyslipidaemias: lipid modification to reduce cardiovascular risk. Eur Heart J. 2020; 41(1): 111–188, doi: 10.1093/eurheartj/ehz455, indexed in Pubmed: 31504418.
16. Cecha P, Chromik A, Piotrowska I, et al. Assessment of application of the new 2019 European Society of Cardiology/ European Atherosclerosis Society Guidelines for the Management of Dyslipidaemias in daily clinical practice - one center study. Folia Med Cracov. 2021; 61(3): 43–54, doi: 10.24425/fmc.2021.138950, indexed in Pubmed: 34882663.
17. Jankowski P, Kosior DA, Sowa P, et al. Secondary prevention of coronary artery disease in Poland. Results from the POLASPIRE survey. Cardiol J. 2020; 27(5): 533–540, doi: 10.5603/CJ.a2020.0072, indexed in Pubmed: 32436589.
18. Jankowski P, Kozieł P, Setny M, et al. Dyslipidemia management in patients with coronary artery disease. Data from the POLASPIRE survey. J Clin Med. 2021; 10(16), doi: 10.3390/jcm10163711, indexed in Pubmed: 34442006.
19. Dyrbuś K, Gąsior M, Desperak P, et al. Risk-factors associated with extremely high cardiovascular risk of mid- and long-term mortality following myocardial infarction: Analysis of the Hyperlipidaemia Therapy in tERtiary Cardiological cEnTer (TERCET) registry. Atherosclerosis. 2021; 333: 16–23, doi: 10.1016/j.atherosclerosis.2021.08.024, indexed in Pubmed: 34418681.
20. Catapano AL, Graham I, De Backer G, et al. 2016 ESC/EAS Guidelines for the Management of Dyslipidaemias: The Task Force for the Management of Dyslipidaemias of the European Society of Cardiology (ESC) and European Atherosclerosis Society (EAS) Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). Atherosclerosis. 2016; 253: 281–344, doi: 10.1016/j.atherosclerosis.2016.08.018, indexed in Pubmed: 27594540.
21. Cybulska B, Szostak WB, Filipiak KJ, et al. Polish Forum for Prevention Guidelines on Dyslipidaemia: Update 2016. Kardiol Pol. 2017; 75(2): 187–190, doi: 10.5603/KP.2017.0031, indexed in Pubmed: 28205202.