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Lipid goal achievement one month after myocardial infarction — observational real-world study from Polish population

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INTRODUCTION

Patients after myocardial infarction (MI) remain at high risk of future cardiovascular events and low-density lipoprotein cholesterol (LDL-C) is one of the major modifiable risk factors [1]. Current guidelines recommend the goal of LDL-C levels below 1.4 mmol/L for this group [1]. The proposed treatments include high-dose statin alone or combination therapy with ezetimibe depending on the LDL-C values and intensity of previous therapy [2]. In addition, PCSK-9 inhibitors (PCSK-9i) can be added when the lipid goal is not achieved after 4–8 weeks despite the highest tolerated combination regimen [3]. Many studies in the Polish population represent the data on one-year lipid goal achievement after MI [4, 5], however, there is a lack of data on one-month follow-up and on clinical predictors of reaching the recommended values. The aim of our study is to fill this gap and assess the potential indication for PCSK-9i therapy one-month after MI.

METHODS

It was a single-center, prospective, pilot study conducted in the Clinical Department of Cardiology in Nowy Sącz, Poland between February 2022 and January 2023 including consecutive patients presenting with acute MI and treated with percutaneous coronary intervention (PCI). Exclusion criteria were: lack of consent or missing data on lipid assessment during the index hospitalization or one month after discharge. Patients underwent the measurements of lipid profile in the first 24 hours (baseline) and one-month after

discharge from the hospital (follow-up). Measurements of high-density lipoprotein cholesterol (HDL-C), LDL-C, total cholesterol, and triglycerides were performed by certified laboratory technicians in the hospital department of laboratory diagnostics, adhering to international standards. Clinical data was obtained from patients and medical records. Achievement of lipid goal was defined as LDL-C level at follow-up <1.4 mmol/L. The medical doctors caring for the patient were given written recommendations on discharge lipid-lowering therapy and lifestyle modifications according to the current consensus [3]. High-dose of statin was defined as >20 mg for rosuvastatin and >40 mg for atorvastatin. All patients provided written informed consent. The study was approved by the Bioethical Committee of Cracow Medical Chamber (No. 280/KBL/OIL/2020) and conducted in accordance with the Declaration of Helsinki. The study complies with the STROBE guidelines for observational studies.

Statistical analysis

Statistical analysis was performed with the SPSS version 28.0 (IBM Corp, Armonk, NY, USA) and R (R Core Team 2021; version 4.1.1). Distribution was assessed using the Kolmogorov-Smirnov test. Normally distributed data was presented as mean (standard deviation), whereas non-parametric variables were presented as median and interquartile range. Differences between the groups were assessed with a T-test, Wilcoxon signed-rank, or Mann-Whitney U test as appropriate. Categorical variables were presented as numbers and percentages. The comparisons between categorical variables were done using the Chi-square test or Fisher's exact test as appropriate. The associations between baseline factors and achievement of lipid goals were evaluated with logistic regression. Adjusted logistic regression models included baseline parameters which achieved $P < 0.1$ in simple logistic regression. All P -values are two-sided, and P -values below 0.05 were considered statistically significant.

RESULTS AND DISCUSSION

In total, 97 patients were included in this study. The median age was 64 (56–69) years and 49 (50.5%) patients presented with ST-elevation MI. In the whole group, 64 (66.0%) patients were treated with a high-dose statin, and additionally 23 (23.7%) with ezetimibe. After one month of follow-up, the lipid goal was achieved in only 30.9% of patients. Patient characteristics are presented in **Table 1**. There were significant reductions in mean LDL-C values at one-month follow-up in relation to baseline [1.69 (0.66) mmol/L vs. 3.6 (1.18) mmol/L, $P < 0.001$], as well as in median HDL-C (1.05, 0.90–1.22 vs. 1.14, 0.97–1.32

mmol/L, $P = 0.001$) and mean total cholesterol [3.36 (0.78) mmol/L vs. 5.36 (1.29) mmol/L, $P < 0.001$] values, without significant differences in median-triglycerides level (1.14, 0.81–1.78 mmol/L vs. 1.16, 0.86–1.56 mmol/L, $P = 0.18$). Patients who achieved lipid goals at one month more frequently had diabetes (43.3% vs. 16.4%, $P = 0.005$), were treated with ezetimibe (40.0% vs. 16.4%, $P = 0.01$), and had lower baseline levels of HDL-C [1.06 (0.21) mmol/L vs. 1.17 (0.24) mmol/L, $P = 0.01$]. There was no significant difference in lipid goal achievement between patients with high-dose statin and non-high-dose statin (31.3% vs. 30.3%, $P = 0.92$). Simple logistic regression revealed associations of diabetes (OR = 3.893, 95%CI:1.477–10.261, $P = 0.006$), ezetimibe treatment (OR = 3.394, 95% CI: 1.280–9.001, $P = 0.01$), and baseline HDL-C levels (OR = 0.120, 95% CI: 0.016–0.917, $P = 0.04$) with the achievement of lipid goals. Similarly, adjusted logistic regression confirmed independent significant associations for diabetes (OR = 3.048, 95% CI: 1.083–8.580, $P = 0.04$), ezetimibe treatment (OR = 3.547, 95% CI: 1.203–10.453, $P = 0.02$) and baseline HDL-C levels (0.091, 95% CI: 0.010–0.830, $P = 0.03$) with lipid goal achievement. 37 patients (38.1%) belonged to an extremely high-risk group, of which only 6 (16.2%) achieved follow-up LDL-C levels < 1.0 mmol/L.

Our study revealed that only 30.9% of patients achieved the lipid goal after one month of guideline-recommended lipid-lowering therapy. According to the current recommendations, more than two-thirds of the study patients should undergo further therapy intensification, suggesting that current guidelines are not effective in the achievement of the optimal lipid target [2, 3]. Accordingly, a recent Polish study including 1499 patients showed, that only one-fifth of participants achieved the LDL-C lipid goal one year after the MI episode [4]. However, in this study, there were no patients treated with PCSK-9i, which are known to significantly lower LDL-C levels and mortality [6, 7]. European DA VINCI study also showed the low efficacy of current lipid-lowering therapies (only 18% of patients with lipid goal achievement in secondary prevention with only 1.1% of patients treated with PCSK-9i [8]). Nevertheless, the overall rate of patients treated with high-dose statin in our study is similar to the previous report from the Polish population (66.0% vs. 67.9%) [9].

Results from our study confirm that combination therapy with ezetimibe is more effective in lowering LDL-C levels. In spite of this, only 23.7% of patients were treated with ezetimibe which unfortunately may delay the achievement of the lipid goal [2, 3, 10]. In the mentioned Polish study, only 3% of patients were prescribed ezetimibe at discharge, with a significant increase to 21.7% at 12 months [4]. Similarly, a low number of patients were treated with ezetimibe in other observational studies, nevertheless, it should be highlighted that they were

based on the older lipid management guidelines [8, 11]. Our results may indicate the potential need for earlier ezetimibe inclusion in current therapeutic schemes.

In our study patients with diabetes significantly more frequently achieved lipid targets which may be explained by the earlier and more intensified treatment. It was reported that patients with diabetes had significantly lower LDL-C levels at admission and were treated with lipid-lowering therapy before admission more frequently [12]. The observed association of lipid goal achievement with lower baseline HDL-C levels is harder to explain and may indicate more favorable lipid metabolism in this patient population. Interestingly, our study did not reveal the significant influence of high-dose statin treatment on lipid goal achievement, however, we cannot exclude the impact of other covariables or the effect of a limited patient number on our findings.

Some study limitations should be acknowledged. It was a single-center study which limits the generalization of the results. Furthermore, the impact of patients' noncompliance with medical recommendations and the direct influence of lifestyle modification on lipid goal achievement were not addressed in the analysis. The lipoprotein (a) and high-sensitivity C-reactive protein levels as well as medications used before the index MI were not assessed.

CONCLUSIONS

In conclusion, our work shows that only a limited number of patients achieve short-term lipid goals, and current lipid management strategies may be insufficient. Therefore, we suggest immediate implementation of ezetimibe therapy, as well as more frequent use of PCSK-9i therapy early after MI [13], but future trials are needed to confirm our results.

Article information

Conflict of interest: None declared.

REFERENCES

1. Visseren FLJ, Mach F, Smulders YM, et al. ESC Scientific Document Group, ESC Scientific Document Group, ESC Scientific Document Group, ESC National Cardiac Societies, ESC Scientific Document Group. 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice. *Eur Heart J.* 2021; 42(34): 3227–3337, doi: [10.1093/eurheartj/ehab484](https://doi.org/10.1093/eurheartj/ehab484), indexed in Pubmed: [34458905](https://pubmed.ncbi.nlm.nih.gov/34458905/).
2. Byrne RA, Rossello X, Coughlan JJ, et al. ESC Scientific Document Group, ESC Scientific Document Group, ESC Scientific Document Group. 2023 ESC Guidelines

- for the management of acute coronary syndromes. *Eur Heart J.* 2023; 44(38): 3720–3826, doi: [10.1093/eurheartj/ehad191](https://doi.org/10.1093/eurheartj/ehad191), indexed in Pubmed: [37622654](https://pubmed.ncbi.nlm.nih.gov/37622654/).
3. Banach M, Penson PE, Vrablik M, et al. ACS EuroPath Central & South European Countries Project. 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](https://doi.org/10.1016/j.phrs.2021.105499), indexed in Pubmed: [33607265](https://pubmed.ncbi.nlm.nih.gov/33607265/).
 4. Nowowiejska-Wiewióra A, Wita K, Mędrala Z, et al. Dyslipidemia treatment and attainment of LDL-cholesterol treatment goals in patients participating in the Managed Care for Acute Myocardial Infarction Survivors program. *Kardiol Pol.* 2023; 81(4): 359–365, doi: [10.33963/KP.a2023.0045](https://doi.org/10.33963/KP.a2023.0045), indexed in Pubmed: [36871294](https://pubmed.ncbi.nlm.nih.gov/36871294/).
 5. 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](https://doi.org/10.24425/fmc.2021.138950), indexed in Pubmed: [34882663](https://pubmed.ncbi.nlm.nih.gov/34882663/).
 6. Schwartz GG, Steg PG, Szarek M, et al. ODYSSEY OUTCOMES Committees and Investigators. Alirocumab and Cardiovascular Outcomes after Acute Coronary Syndrome. *N Engl J Med.* 2018; 379(22): 2097–2107, doi: [10.1056/NEJMoa1801174](https://doi.org/10.1056/NEJMoa1801174), indexed in Pubmed: [30403574](https://pubmed.ncbi.nlm.nih.gov/30403574/).
 7. Sabatine MS, Giugliano RP, Keech AC, et al. FOURIER Steering Committee and Investigators. Evolocumab and Clinical Outcomes in Patients with Cardiovascular Disease. *N Engl J Med.* 2017; 376(18): 1713–1722, doi: [10.1056/NEJMoa1615664](https://doi.org/10.1056/NEJMoa1615664), indexed in Pubmed: [28304224](https://pubmed.ncbi.nlm.nih.gov/28304224/).
 8. Ray K, Molemans B, Schoonen W, et al. EU-Wide Cross-Sectional Observational Study of Lipid-Modifying Therapy Use in Secondary and Primary Care: the DA VINCI study. *European Journal of Preventive Cardiology.* 2020; 28(11): 1279–1289, doi: [10.1093/eurjpc/zwaa047](https://doi.org/10.1093/eurjpc/zwaa047).
 9. Jankowski P, Koziel 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](https://doi.org/10.3390/jcm10163711), indexed in Pubmed: [34442006](https://pubmed.ncbi.nlm.nih.gov/34442006/).
 10. Lewek J, Niedziela J, Desperak P, et al. Intensive Statin Therapy Versus Upfront Combination Therapy of Statin and Ezetimibe in Patients With Acute Coronary Syndrome: A Propensity Score Matching Analysis Based on the PL-ACS Data. *J Am*

Heart Assoc. 2023; 12(18): e030414, doi: [10.1161/JAHA.123.030414](https://doi.org/10.1161/JAHA.123.030414), indexed in Pubmed: [37671618](https://pubmed.ncbi.nlm.nih.gov/37671618/).

11. Mackinnon ES, Leiter LA, Wani RJ, et al. Real-World Risk of Recurrent Cardiovascular Events in Atherosclerotic Cardiovascular Disease Patients with LDL-C Above Guideline-Recommended Threshold: A Retrospective Observational Study. *Cardiol Ther.* 2024; 13(1): 205–220, doi: [10.1007/s40119-024-00349-6](https://doi.org/10.1007/s40119-024-00349-6), indexed in Pubmed: [38285331](https://pubmed.ncbi.nlm.nih.gov/38285331/).
12. Ferrières J, Lautsch D, Bramlage P, et al. Lipid-lowering treatment and low-density lipoprotein cholesterol target achievement in patients with type 2 diabetes and acute coronary syndrome. *Arch Cardiovasc Dis.* 2020; 113(10): 617–629, doi: [10.1016/j.acvd.2020.05.013](https://doi.org/10.1016/j.acvd.2020.05.013), indexed in Pubmed: [32873522](https://pubmed.ncbi.nlm.nih.gov/32873522/).
13. Nicholls SJ. PCSK9 inhibitors and reduction in cardiovascular events: Current evidence and future perspectives. *Kardiol Pol.* 2023; 81(2): 115–122, doi: [10.33963/KP.a2023.0030](https://doi.org/10.33963/KP.a2023.0030), indexed in Pubmed: [36739653](https://pubmed.ncbi.nlm.nih.gov/36739653/).

Table 1. Patient characteristics

	N = 97
Age (years)	64 (56–69)
BMI (kg/m ²)	27.58 (25.25–31.16)
Man (n)	81 (83.5%)
STEMI (n)	49 (50.5%)
NSTEMI (n)	47 (48.5%)
Hypertension (n)	82 (84.5%)
Hypercholesterolemia (n)	90 (92.8%)
Diabetes Mellitus (n)	24 (24.7%)
Chronic kidney disease (n)	3 (3.1%)
Heart Failure (n)	24 (24.7%)
Peripheral artery disease (n)	4 (4.1%)
Atrial Fibrillation (n)	5 (5.2%)
Chronic obstructive pulmonary disease (n)	2 (2.1%)
Previous myocardial infarction (n)	13 (13.4%)
Previous PCI (n)	15 (15.5%)
Nicotinism (n)	18 (18.6%)
Multivessel procedure (n)	32 (33.0%)
Stent length (mm)	32 (18–52)
Clopidogrel (n)	18 (18.6%)
Ticagrelor (n)	69 (71.1%)
Prasugrel (n)	10 (10.3%)

Atorvastatin (n)	38 (39.2%)
Rosuvastatin (n)	59 (60.8%)
Ezetimibe (n)	23 (23.7%)
High dose statin (n)	64 (66.0%)
Total cholesterol level at baseline (mmol/L)	5.36 (1.29)
LDL-C level at baseline (mmol/L)	3.60 (1.18)
HDL-C level at baseline (mmol/L)	1.14 (0.97–1.32)
Triglicerydes level at baseline (mmol/L)	1.14 (0.81–1.78)
Total cholesterol level at follow-up (mmol/L)	3.36 (0.78)
LDL-C level at follow-up (mmol/L)	1.69 (0.66)
HDL-C level at follow-up (mmol/L)	1.08 (0.24)
Triglicerydes level at follow-up (mmol/L)	1.16 (0.86–1.56)
Difference in total cholesterol level (mmol/L)	–2.00 (1.41)
Difference in LDL-C level (mmol/L)	–1.91 (1.27)
Difference in HDL-C level (mmol/L)	–0.06 (0.17)
Difference in tryglicerydes level (mmol/L)	–0.40 (–0.44 – –0.36)
Lipid goal achievement (LDL-C <1.4 mmol/L) (n)	30 (30.9%)
≥50% reduction of LDL-C level (n)	52 (53.6%)

Abbreviations: BMI — body mass index; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; NSTEMI, non-ST-elevation myocardial infarction; PCI — percutaneous coronary intervention STEMI, ST-elevation myocardial infarction;