Lipid goal achievement one month after myocardial infarction: Observational real-world study from the Polish population

Aleksander Zeliaś[1, 2], Adrian Bednarek[3], Dominika Dykla[1, 2], Renata Wysocka[4], Paulina Szczygiel[2], Dariusz Dudek[5]

[1]Faculty of Medicine and Health Science, University of Applied Science in Nowy Sacz, Nowy Sącz, Poland
[2]2nd Clinical Department of Cardiology, Faculty of Medicine and Health Science, University of Applied Science in Nowy Sacz, Nowy Sącz, Poland
[3]1st Department of Cardiology, Medical University of Warsaw, Warszawa, Poland
[4]1st Clinical Department of Cardiology, Faculty of Medicine and Health Science, University of Applied Science in Nowy Sacz, Nowy Sącz, Poland
[5]Center for Digital Medicine and Robotics, Jagiellonian University Medical College, Kraków, Poland

Correspondence to:
Adrian Bednarek,
1st Department of Cardiology, Medical University of Warsaw, Banacha 1a, 02–097 Warszawa, Poland,
phone: +48 22 599 19 51,
e-mail: adikbednarek@gmail.com

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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 LDL-C level of below 1.4 mmol/l for this group [1]. The proposed treatments include high-dose statins alone or in combination therapy with ezetimibe depending on the LDL-C values and the 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 Polish populations have presented the data on one-year lipid goal achievement after MI [4, 5]. However, there is a lack of data regarding one-month follow-up and on clinical predictors of reaching the recommended values. The aim of our study was to fill this gap and to assess the potential indication for PCSK-9i therapy one month after MI.

METHODS

This was a single-center, prospective, pilot study conducted in the Clinical Department of Cardiology in the University of Applied Science in Nowy Sacz, Poland between February 2022 and January 2023 including consecutive patients presenting with acute MI who were treated with percutaneous coronary intervention (PCI). Exclusion criteria were a lack of consent or missing data on lipid assessment during the index hospitalization or one month after discharge. Patients underwent measurements of lipid profile in the first 24 hours (baseline) and one month after discharge from 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 were obtained from patients and medical records. Achievement of lipid goal was defined as an LDL-C level at follow-up of <1.4 mmol/l. The doctors caring for the patient were given written recommendations on discharge lipid-lowering therapy and lifestyle modifications according to the current consensus [3]. A high dose of statin was defined as >20 mg for rosuvastatin and >40 mg for atorvastatin. All patients provided written informed consent. This study was approved by the Bioethical Committee of Krakow Medical Chamber (No. 280/KBL/OIL/2020) and conducted in accordance with the Declaration of Helsinki. This study complied with the STROBE guidelines for observational studies.

Statistical analysis

Statistical analysis was performed with SPSS version 28.0 (IBM Corp, Armonk, NY, US) and R (R Core Team 2021; version 4.1.1). Distribution was assessed using the Kolmogorov–Smirnov test. Normally distributed data were presented as means (standard devia-

tions), whereas non-parametric variables were presented as medians and interquartile ranges. 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. Comparisons between categorical variables were done using the Chi-square test or Fisher's exact test as appropriate. 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 were 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-segment elevation MI. In the whole group, 64 (66.0%) patients were treated with high-dose statins, 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 set out 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, but there were no 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 statins (31.3% vs. 30.3%; P = 0.92). Simple logistic regression showed associations between 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) and 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 whom only 6 (16.2%) achieved follow-up LDL-C levels of <1.0 mmol/l.

Our study demonstrated 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 study patients should undergo further therapy intensification, suggesting that current guidelines are not effective in the achievement of the optimal lipid target [2, 3]. In alignment with this, a recent Polish study including 1499 patients showed that only one in 5 participants achieved the LDL-C lipid goal one year after an MI episode [4]. However, in that study, there were no patients treated with PCSK-9i, which are known to significantly lower LDL-C levels and mortality [6, 7]. The European DA VINCI study also showed 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 number of patients treated with high-dose statins in our study is similar to a previous report from a Polish population (66.0% vs. 67.9%) [9].

The results from our study confirm that combination therapy with ezetimibe is more effective in lowering

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 to –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-segment elevation myocardial infarction; PCI, percutaneous coronary intervention STEMI, ST-segment elevation myocardial infarction

LDL-C levels. Despite 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 abovementioned earlier Polish study, only 3% of patients were prescribed ezetimibe on discharge, with a significant increase to 21.7% at 12 months [4]. Similarly, a small number of patients were treated with ezetimibe in other observational studies. However, it should be highlighted that those studies 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 achieved lipid targets significantly more frequently, which may be explained by the earlier and more intensive treatment. It has been reported that patients with diabetes have significantly lower LDL-C levels on admission, and are 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, but may indicate more favorable lipid metabolism in this patient population. Interestingly, our study did not show a significant influence of high-dose statin treatment on lipid goal achievement, although we cannot exclude the impact of other covariables or the effect of a limited number of patients on our findings.

Some study limitations should be acknowledged. This 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 modifications 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

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], although future trials are needed to confirm our results.

Article information

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