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ABOUT COVER

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ORIGINAL ARTICLE

Observational Study

Assessment of post-myocardial infarction lipid levels and management: Results from a tertiary care hospital of Pakistan

Rubina Rauf, Muhammad Ismail Soomro, Muhamman Nauman Khan, Mukesh Kumar, Najia Aslam Soomro, Khawar Abbas Kazmi

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Abstract

BACKGROUND

Lipid treatment practices and levels in post-acute myocardial infarction (AMI) patients, which are crucial for secondary prevention.

AIM

To evaluate the lipid treatment practices and lipid levels in post-myocardial infarction (MI) patients at a tertiary care hospital in Pakistan.

METHODS

In this cross-sectional study, we analyzed patients who had experienced their first AMI event in the past 3 years. We assessed fasting and non-fasting lipid profiles, reviewed statin therapy prescriptions, and examined patient compliance. The recommended dose was defined as rosuvastatin ≥ 20 mg or atorvastatin ≥ 40 mg, with target total cholesterol levels set at < 160 mg/dL and target low-density lipoprotein cholesterol (LDL-C) at < 55 mg/dL.

RESULTS

Among 195 patients, 71.3% were male, and the mean age was 57.1 ± 10.2 years. The median duration since AMI was 36 (interquartile range: 10-48) months and 60% were diagnosed with ST-segment elevation MI. Only 13.8% of patients were advised to undergo lipid profile testing after AMI, 88.7% of patients were on the recommended statin therapy, and 91.8% of patients were compliant with statin therapy. Only 11.5% had LDL-C within the target range and 71.7% had total

cholesterol within the target range. Hospital admission in the past 12 months was reported by 14.4%, and the re-admission rate was significantly higher among non-compliant patients (37.5% *vs* 5.6%). Subsequent AMI event rate was also significantly higher among non-compliant patients (43.8% *vs* 11.7%).

CONCLUSION

Our study highlights that while most post-AMI patients received the recommended minimum statin therapy dose, the inadequate practice of lipid assessment may compromise therapy optimization and raise the risk of subsequent events.

Key Words: Lipid profile; Dyslipidemia; Acute myocardial infarction; Secondary prevention; Lipid lowering therapy

Core Tip: Lipid treatment practices and levels in post-acute myocardial infarction (AMI) patients, which are crucial for secondary prevention. This study examined lipid treatment practices and levels in post-AMI patients at a Pakistani tertiary care hospital. Among 195 patients, only 13.8% underwent lipid profile testing post-AMI. While 88.7% received recommended statin therapy, only 11.5% achieved target low-density lipoprotein cholesterol levels. Non-compliance with statin therapy correlated with higher re-admission and subsequent AMI rates. The findings underscore the importance of optimizing lipid assessment practices to reduce the risk of recurrent events in post-AMI patients.

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INTRODUCTION

Acute myocardial infarction (AMI) stands as a global leading cause of mortality. Following AMI, meticulous management of patient's lipid levels for secondary prevention becomes paramount. This specific patient group is at high risk, with a particular focus on reducing low-density lipoprotein cholesterol (LDL-C) levels to recommended ranges, as elevated LDL-C levels significantly contribute to acute coronary events[1]. Despite aggressive cholesterol control with statins in post-MI patients, a lingering risk for further cardiovascular events persists. Shockingly, within the 2 years following an acute coronary event, approximately 20% of survivors experience another coronary event, and their 5-year mortality rate escalates, ranging from 19% to 22%[2].

Assessing and managing the lipid profile serve as the cornerstone of secondary prevention, yet patients typically receive inadequate treatment following an acute coronary event[3,4]. Various studies have illuminated the fact that most patients experience suboptimal dyslipidemia treatment, leading to a heightened future risk of cardiovascular events. Although many patients with acute coronary syndrome (ACS) are prescribed high-intensity statins for secondary prevention, a significant number remains undertreated, failing to achieve therapeutic goals[5,6]. Therefore, the management of hypercholesterolemia in these patients is of paramount importance to mitigate future cardiovascular risks.

International guidelines on lipid management for secondary prevention in post-MI patients exhibit slight variations, emphasizing the significance of assessing individual patient risk in making informed decisions. The 2021 guidelines from the European Society of Cardiology (ESC) advocate for a 50% reduction in LDL-C levels to achieve a value of < 1.4 mmol/L (55 mg/dL) in individuals following an acute coronary event[7]. The ESC guidelines also suggest repeating lipid profiles in patients after an acute coronary event within four to six weeks to optimize lipid-lowering therapy. Conversely, the National Institute for Health and Care Excellence guidelines recommend a 40% reduction in non-high-density lipoprotein cholesterol (non-HDL-C) in patients with ACS, along with a lipid profile reassessment 3 months after initiating lipid-lowering therapy. Furthermore, the third report from the National Cholesterol Education Program Adult Treatment Panel (ATP III) underscores cardiovascular risk reduction through treatment to LDL-C targets[8]. The ATP III guidelines set an LDL-C target of < 100 mg/dL for patients with established coronary artery disease (CAD) and < 70 mg/dL for patients with ACS. Despite these recommendations, achieving guideline-recommended LDL-C goals remains suboptimal in real-world settings[9-11].

Recognizing the pivotal role of statins in minimizing the risk of subsequent cardiovascular events is crucial. However, statin monotherapy may fall short in achieving target goals in many high-risk patients, necessitating the use of statin combination therapy with other non-statin lipid-lowering agents as the optimal therapeutic approach. This underscores the importance of evaluating and ensuring adequate lipid management in patients following an acute cardiovascular event, particularly in those admitted to tertiary care centers, to minimize the future risk of cardiovascular morbidity and mortality. Hence, in this study, we aimed to evaluate the lipid profile treatment practices and lipid levels in post-MI patients at a tertiary care hospital in Pakistan.

MATERIALS AND METHODS

Between August 2022 and February 2023, a single-center cross-sectional study was conducted at the National Institute of Cardiovascular Disease (NICVD) in Karachi, Pakistan. The study aimed to assess post-myocardial infarction (MI) patients visiting the cardiology outpatient clinic for secondary prevention and further management. Eligible participants included individuals aged 18 and above who had experienced their first acute coronary event within the past 3 years. Ethical clearance was obtained from the hospital's ethics committee, and verbal informed consent was acquired from patients, providing a detailed explanation of the study's purpose and benefits.

Our study standards were aligned with the 2021 ESC guidelines on cardiovascular disease (CVD) prevention in clinical practice. These standards included achieving LDL-C levels below 55 mg/dL, which necessitated a 50% reduction from baseline. Additionally, we stipulated that a repeat lipid profile should be obtained six weeks after the initial clinic presentation. For patients who did not reach the lipid reduction target (> 50% LDL-C reduction from baseline or LDL-C < 55 mg/dL), or those who could not tolerate statin therapy, the guidelines recommended the addition of other lipid-lowering agents, in a preferred order, to high-intensity statins. We also documented pre-MI statin use, post-discharge statin type and dose.

High-intensity statin therapy was defined as daily rosuvastatin ≥ 20 mg or atorvastatin ≥ 40 mg, while moderate-intensity statin therapy encompassed daily rosuvastatin between 5 and 19 mg, or atorvastatin between 10 and 39 mg, pravastatin ≥ 40 mg, simvastatin ≥ 20 mg, fluvastatin ≥ 80 mg, lovastatin ≥ 40 mg, and pitavastatin ≥ 2 mg. All other combinations of statin type and dose were considered low intensity.

Data collected for the study encompassed demographics, medical history regarding co-morbid conditions, presentation ["ST-segment elevation MI (STEMI)" or non-STEMI], family history of CAD, diabetes, hypertension, waist circumference (cm), body mass index (kg/m^2), heart rate, systolic blood pressure, lipid profile before the cardiovascular event, and pre-MI statin use. Additionally, last available lipid profiles were assessed for all the patients.

To estimate the proportion of patients meeting guideline-recommended cholesterol targets based on their LDL-C levels and prescribed statin intensity at discharge, we conducted statistical analysis using IBM Statistical Package for Social Sciences 21. Patients were categorized into sub-groups based on their adherence to recommended statin dosages, total cholesterol levels (target < 160 mg/dL), and LDL cholesterol levels (target < 55 mg/dL). Data comparisons between these groups were performed using independent sample *t*-tests or χ^2 tests as appropriate. Univariate and multivariable binary logistic regression analyses were employed to identify clinical and demographic factors associated with achieving target total cholesterol levels, LDL levels, and recommended statin dosages. All analyses were conducted at a significance level of 5%.

RESULTS

Among the 195 post-AMI patients in our study, 71.3% were male, with a mean age of 57.1 ± 10.2 years. The primary diagnosis was STEMI for 60% of patients. The median time since the first acute MI event was 36 (interquartile range: 10-48) months. Most patients (88.7%) were on the recommended statin therapy, predominantly Rosuvastatin (91.8%), with only 2.6% were prescribed Atorvastatin. Lipid profile assessment was advised for only 13.8% of patients after AMI. Compliance with prescribed statin therapy was high at 91.8%. Total cholesterol was within the target range (< 160 mg/dL) in 71.7% of patients, while LDL-cholesterol met the target (< 55 mg/dL) in only 11.5%. Over the past 12 months, 14.4% of patients had at least one hospital admission (Table 1).

The majority of patients (91.8%) demonstrated compliance with their statin therapy, while 8.2% (16) of patients were non-compliant, primarily due to affordability concerns (reported by 15 patients) or dizziness (reported by 1 patient).

Notably, non-compliant patients had a significantly higher hospital admission rate in the past 12 months, with an event rate of 37.5% (6/16), compared to 5.6% (10/179) among compliant patients (P < 0.001). Similarly, the subsequent ACS event rate was significantly higher among non-compliant patients, with an event rate of 43.8% (7/16), compared to 11.7% (21/179) among compliant patients (P < 0.001).

It is worth noting that both univariate and multivariable regression analyses did not reveal any statistically significant clinical factors associated with the target total cholesterol (Table 2).

The univariate and multivariable regression analysis revealed significantly lower prevalence of the target LDL cholesterol levels for the middle aged (41-65 years) patients as compared to younger patients (up to 40 years) with an adjusted odds ratio of 0.17 (95%CI: 0.03-0.85; P = 0.031) (Table 3).

Similarly, the univariate and multivariable regression analysis revealed no statistically significant clinical associates of the recommended dose of statin (Table 4).

DISCUSSION

Recent evidence has solidified the understanding that the primary trigger for atherosclerosis is the retention of cholesterol, primarily LDL, within the arterial walls. The pivotal role of LDL and other apo-B containing lipoproteins in the progression of atherosclerotic CVD (ASCVD) has been substantiated through various genetic, observational, and interventional studies[12]. The results of our study shed light on the crucial aspects of lipid profile management in post-AMI patients, which play a pivotal role in secondary prevention. Our primary aim was to evaluate the practices and lipid levels in this specific patient population to better understand the state of secondary prevention in clinical practice. In our

Table 1 Distribution of demographic and clinical characteristics of post-acute myocardial infarction patients, *n* (%)

	Total	Statin therapy		*P* value
		Not on recommended dose	On recommended dose	
Total	195	22 (11.3)	173 (88.7)	-
Gender				
Male	139 (71.3)	15 (68.2)	124 (71.7)	0.733
Female	56 (28.7)	7 (31.8)	49 (28.3)	
Age (mean ± SD, yr)	57.1 ± 10.2	57.8 ± 11.6	57 ± 10	0.728
≤ 40	11 (5.6)	2 (9.1)	9 (5.2)	0.558
41-65	150 (76.9)	15 (68.2)	135 (78)	
> 65	34 (17.4)	5 (22.7)	29 (16.8)	
Weight (mean ± SD, kg)	73.4 ± 14.7	76.6 ± 15.2	72.9 ± 14.6	0.268
Height (mean ± SD, cm)	155.5 ± 7.7	159.9 ± 7.5	154.9 ± 7.5	0.004
Body mass index (mean ± SD, kg/m^2)	30.4 ± 5.8	30.2 ± 6.6	30.4 ± 5.8	0.857
Underweight (< 18.5)	1 (0.5)	0 (0)	1 (0.6)	0.185
Healthy weight (18.5-22.9)	16 (8.2)	4 (18.2)	12 (6.9)	
Above ideal range (≥ 23)	178 (91.3)	18 (81.8)	160 (92.5)	
Waist circumference (mean ± SD, cm)	97.2 ± 8.8	101.5 ± 11.7	96.7 ± 8.2	0.016
DM	82 (42.1)	11 (50)	71 (41)	0.423
Duration of DM (mean ± SD)	9.1 ± 5.3	9.5 ± 6.2	9.1 ± 5.2	0.832
Well controlled	13 (15.9)	3 (27.3)	10 (14.1)	0.265
HTN	100 (51.3)	12 (54.5)	88 (50.9)	0.745
Duration of HTN (mean ± SD)	8.1 ± 4.4	6.9 ± 3.4	8.2 ± 4.5	0.342
Well controlled	54 (54)	11 (91.7)	43 (48.9)	0.005
Tobacco	83 (42.6)	6 (27.3)	77 (44.5)	0.124
Duration of tobacco use (mean ± SD)	19.1 ± 9.1	15.4 ± 8.2	19.4 ± 9.2	0.296
Chewing	6 (7.2)	2 (33.3)	4 (5.2)	0.073
Chewing, smoking	6 (7.2)	0 (0)	6 (7.8)	
Smoking	71 (85.5)	4 (66.7)	67 (87)	
Family history of coronary artery diseases	101 (51.8)	17 (77.3)	84 (48.6)	0.011
AMI				
STEMI	117 (60)	15 (68.2)	102 (59)	0.406
NSTEMI	78 (40)	7 (31.8)	71 (41)	
Duration science first event of AMI (month)	36 (10-48)	36 (10-72)	30 (10-48)	0.299
Number of hospital admissions (in last 12 months)				
0	167 (85.6)	15 (68.2)	152 (87.9)	0.001
1	23 (11.8)	4 (18.2)	19 (11)	
2	5 (2.6)	3 (13.6)	2 (1.2)	
Lipid profile advised after AMI	27 (13.8)	6 (27.3)	21 (12.1)	0.053
Are you taken statins after 1st event of AMI?	185 (94.9)	12 (54.5)	173 (100)	< 0.001
Duration [median (IQR), month]	24 (9-48)	26 (6.5-66)	24 (10-48)	0.818

What is the dose of statin you are taking?				
Rosuvastatin	179 (91.8)	7 (31.8)	172 (99.4)	-
Not taking	16 (8.2)	15 (68.2)	1 (0.6)	< 0.001
10 mg	7 (3.6)	7 (31.8)	0 (0)	
20 mg	172 (88.2)	0 (0)	172 (99.4)	
Atervastatin	5 (2.6)	4 (18.2)	1 (0.6)	-
Not taking	190 (97.4)	18 (81.8)	172 (99.4)	< 0.001
20 mg	4 (2.1)	4 (18.2)	0 (0)	
40 mg	1 (0.5)	0 (0)	1 (0.6)	
Simvastatin	1 (0.5)	1 (4.5)	0 (0)	-
Not taking	194 (99.5)	21 (95.5)	173 (100)	0.005
10 mg	1 (0.5)	1 (4.5)	0 (0)	
Did you ever lipid profile get done before AMI event?	4 (2.1)	1 (4.5)	3 (1.7)	0.381
Total cholesterol (last lipid profile)				
Available	191 (97.9)	22 (100)	169 (97.7)	-
Level (mean ± SD)	143.1 ± 38.7	143 ± 35.6	143.1 ± 39.2	0.986
Level [median (IQR)]	140 (115-165)	136 (115-165)	144 (115-163)	0.818
Target total cholesterol (< 160)	137 (71.7)	16 (72.7)	121 (71.6)	0.912
LDL-cholesterol (last lipid profile)				
Available	191 (97.9)	21 (95.5)	170 (98.3)	-
Level (mean ± SD)	91.7 ± 34.8	94.7 ± 42.5	91.3 ± 33.8	0.676
Level [median (IQR)]	88 (66-110)	83 (65-94)	88.5 (67-110)	0.989
Target LDL cholesterol (< 55)	22 (11.5)	2 (9.5)	20 (11.8)	0.762
HDL-cholesterol (last lipid profile)				
Available	192 (98.5)	22 (100)	170 (98.3)	-
Level (mean ± SD)	40.9 ± 8.7	41.2 ± 10	40.8 ± 8.6	0.846
Level [median (IQR)]	42 (36-45)	42.5 (37-49)	41.5 (36-45)	0.466
Triglycerides (last lipid profile)				
Available	165 (84.6)	17 (77.3)	148 (85.5)	-
Level (mean ± SD)	167.6 ± 76.4	185.4 ± 125	165.5 ± 69.1	0.311
Level [median (IQR)]	150 (123-190)	152 (125-167)]	150 (123-190)	0.782
Were you taken statins before 1st event of AMI?	3 (1.5)	0 (0)	3 (1.7)	0.534
Duration [median (IQR), month]	36 (12-48)	-	36 (12-48)	-
History of subsequent ACS event	16 (8.2)	3 (13.6)	13 (7.5)	0.324
Compliant to the statin therapy	179 (91.8)	12 (54.5)	167 (96.5)	< 0.001
If no what are the reasons?				
Affordability	15 (7.7)	9 (40.9)	6 (3.5)	< 0.001
Dizziness	1 (0.5)	1 (4.5)	0 (0)	

AMI: Acute myocardial infarction; HDL: High-density lipoprotein; LDL: Low-density lipoprotein; STEMI: ST-segment elevation myocardial infarction; NSTEMI: Non-ST elevation myocardial infarction; ACS: Acute coronary syndrome; IQR: Interquartile range; DM: Diabetes mellitus; HTN: Hypertension.

Table 2 Univariate and multivariable binary logistic regression analysis for the clinical associates of the target total cholesterol

Target total cholesterol (< 160)	Univariate		Multivariable	
	OR (95%CI)	*P* value	OR (95%CI)	*P* value
Gender				
Male	1	-	1	-
Female	1.07 (0.53-2.16)	0.845	1.43 (0.61-3.38)	0.411
Age (yr)				
≤ 40	1	-	1	-
41-65	0.23 (0.03-1.88)	0.172	0.18 (0.02-1.53)	0.116
> 65	0.27 (0.03-2.39)	0.238	0.18 (0.02-1.74)	0.137
Body mass index (kg/m^2)				
< 23	1	-	1	-
≥ 23	0.76 (0.24-2.45)	0.650	0.75 (0.2-2.73)	0.657
Waist circumference (cm)	0.99 (0.96-1.03)	0.743	1 (0.95-1.04)	0.859
DM				
Non-DM	1	-	1	-
DM	0.96 (0.51-1.82)	0.901	0.94 (0.47-1.87)	0.864
HTN				
Non-HTN	1	-	1	-
HTN	0.97 (0.52-1.82)	0.925	1.06 (0.55-2.06)	0.854
Tobacco user				
No	1	-	1	-
Yes	1.22 (0.64-2.33)	0.537	1.43 (0.66-3.14)	0.366
Family history of coronary artery diseases				
No	1	-	1	-
Yes	1.03 (0.55-1.93)	0.930	0.94 (0.48-1.81)	0.843
Acute myocardial infarction				
STEMI	1	-	1	-
NSTEMI	0.98 (0.51-1.85)	0.940	1.05 (0.54-2.04)	0.893
Lipid profile advised after acute myocardial infarction				
No	1	-	1	-
Yes	0.71 (0.29-1.7)	0.441	0.58 (0.23-1.47)	0.247
Statin therapy after acute myocardial infarction				
No	1	-	1	-
Yes	0.62 (0.13-3.02)	0.554	0.52 (0.1-2.78)	0.446

OR: Odds ratio; CI: Confidence interval; DM: Diabetes mellitus; HTN: Hypertension; STEMI: ST-segment elevation myocardial infarction; NSTEMI: Non-ST elevation myocardial infarction.

cohort of 195 post-AMI patients, we observed some noteworthy trends. Firstly, it is concerning that only 13.8% of the patients were advised to undergo lipid profile testing after their AMI event. This low rate of lipid assessment raises concerns about the adequacy of secondary prevention strategies. Monitoring lipid profiles is a fundamental step in managing cardiovascular risk and tailoring therapeutic interventions. The suboptimal rate of lipid assessment suggests a potential gap in post-AMI care.

Many clinical trials have demonstrated that the CVD risk reduction is proportional to the reduction in LDL-C levels, it is not important which statin is used to achieve the goal, and lower limit of LDL-C levels is not defined[5]. Greater absolute risk reduction in patients with a high or very high risk of future cardiovascular event can be achieved even with

Table 3 Univariate and multivariable binary logistic regression analysis for the clinical associates of the target low-density lipoprotein cholesterol

Target LDL cholesterol (< 55)	Univariate		Multivariable	
	OR (95%CI)	*P* value	OR (95%CI)	*P* value
Gender				
Male	1	-	1	-
Female	1.18 (0.45-3.06)	0.739	1.09 (0.32-3.72)	0.884
Age (yr)				
≤ 40	1	-	1	-
41-65	0.2 (0.05-0.76)	0.018	0.17 (0.03-0.85)	0.031
> 65	0.18 (0.03-0.97)	0.046	0.14 (0.02-1.07)	0.058
Body mass index (kg/m^2)				
< 23	1	-	1	-
≥ 23	0.57 (0.15-2.17)	0.412	0.34 (0.06-1.84)	0.211
Waist circumference (cm)	1.02 (0.97-1.08)	0.354	1.04 (0.98-1.11)	0.210
DM				
Non-DM	1	-	1	-
DM	0.61 (0.24-1.58)	0.312	0.4 (0.14-1.17)	0.094
HTN				
Non-HTN	1	-	1	-
HTN	0.92 (0.38-2.24)	0.855	0.96 (0.35-2.68)	0.942
Tobacco user				
No	1	-	1	-
Yes	0.6 (0.23-1.54)	0.289	0.59 (0.18-1.93)	0.386
Family history of coronary artery diseases				
No	1	-	1	-
Yes	1.39 (0.57-3.44)	0.470	1.42 (0.53-3.84)	0.485
Acute myocardial infarction				
STEMI	1	-	1	-
NSTEMI	0.4 (0.14-1.12)	0.082	0.41 (0.13-1.31)	0.133
Lipid profile advised after acute myocardial infarction				
No	1	-	1	-
Yes	0.27 (0.04-2.13)	0.216	0.15 (0.02-1.39)	0.095
Statin therapy after acute myocardial infarction				
No	1	-	1	-
Yes	1.04 (0.12-8.76)	0.969	1.45 (0.11-18.39)	0.775

LDL: Low-density lipoprotein; OR: Odds ratio; CI: Confidence interval; DM: Diabetes mellitus; HTN: Hypertension; STEMI: ST-segment elevation myocardial infarction; NSTEMI: Non-ST elevation myocardial infarction.

small reduction in LDL-C levels[13]. Treatment goal should be focused on maintaining LDL-C levels to the recommended target, keeping an eye on drug tolerance and affordability. The recommended levels of LDL-C is < 1.4 mmol/L (55 mg/dL) and a > 50% reduction in LDL-C from the baseline is the treatment goal in patients with established CVD.

On a more positive note, a substantial proportion (88.7%) of the patients were on the recommended statin therapy, which includes Rosuvastatin and Atorvastatin at specific doses. Furthermore, our study found that the majority of patients (91.8%) were compliant with their prescribed statin therapy. However, the most concerning aspect of our findings is that only 11.5% of the patients had LDL-cholesterol levels within the target range, and 71.7% had total

Table 4 Univariate and multivariable binary logistic regression analysis for the clinical associates of the recommended dose of statin

Recommended dose of statin	Univariate		Multivariable	
	OR (95%CI)	*P* value	OR (95%CI)	*P* value
Gender				
Male	1	-	1	-
Female	0.85 (0.33-2.2)	0.733	1.91 (0.55-6.67)	0.325
Age (yr)				
≤ 40	1	-	1	-
41-65	2 (0.39-10.13)	0.402	1.58 (0.25-9.99)	0.395
> 65	1.29 (0.21-7.82)	0.783	0.48 (0.06-4.09)	0.213
Body mass index (kg/m^2)				
< 23	1	-	1	-
≥ 23	2.74 (0.81-9.28)	0.107	14 (2.42-80.95)	0.806
Waist circumference (cm)	0.94 (0.89-0.99)	0.018	0.89 (0.83-0.95)	0.890
DM				
Non-DM	1	-	1	-
DM	0.7 (0.29-1.69)	0.424	0.64 (0.23-1.79)	0.286
HTN				
Non-HTN	1	-	1	-
HTN	0.86 (0.35-2.1)	0.745	1.38 (0.47-4.03)	0.354
Tobacco user				
No	1	-	1	-
Yes	2.14 (0.8-5.73)	0.130	2.08 (0.58-7.51)	0.799
Family history of coronary artery diseases				
No	1	-	1	-
Yes	0.28 (0.1-0.79)	0.016	0.2 (0.06-0.64)	0.098
Acute myocardial infarction				
STEMI	1	-	1	-
NSTEMI	1.49 (0.58-3.84)	0.408	1.6 (0.51-5.06)	0.579
Lipid profile advised after acute myocardial infarction				
No	1	-	1	-
Yes	0.37 (0.13-1.05)	0.061	0.21 (0.06-0.74)	0.130

OR: Odds ratio; CI: Confidence interval; DM: Diabetes mellitus; HTN: Hypertension; STEMI: ST-segment elevation myocardial infarction; NSTEMI: Non-ST elevation myocardial infarction.

cholesterol within the target range. These results indicate that, despite a substantial proportion of patients receiving and adhering to statin therapy, many are not achieving the desired lipid profile targets. This could be attributed to various factors, such as inadequate dosage, inadequate medication adjustment over time, or even genetic predisposition. The suboptimal achievement of target lipid levels underscores the importance of ongoing monitoring and personalized adjustments in lipid-lowering therapy.

If the treatment targets are not achieved with the maximum recommended dose of statin, combination with other lipid lowering agent like ezetimabe is recommended. Combination therapy with proprotein convertase subtilisin/kexin type 9 (PCSK9) inhibiter is recommended if combination of statin with ezetimabe is not helpful for achieving the target goals [14]. Those patients who are already taking maximum tolerated statin but experience a second cardiovascular event within 2 years of the first CVD event (type may be different), LDL-C levels of 40 mg/dL (1.0 mmol/L) may be the treatment target[14]. Till now none of the clinical trials have demonstrated target goals for HDL-C levels, although high HDL-C is associated with future risk reduction in patients with established ASCVD[14].

A goal-oriented approach to lipid-lowering therapy necessitates regular and timely lipid testing. Our study revealed consistently low lipid testing rates (13.8%) among post-MI patients, and there was no discernible preference for testing in those individuals who required statin dose adjustments. Similarly, the rates of lipid testing remained low for patients who had recently been prescribed statin therapy. Interestingly, a significant majority (88.2%) of patients discharged on a high-intensity statin were more likely to undergo lipid testing. This underscores the importance of targeted lipid management as an integral, multi-step process for secondary prevention. Specifically, post-MI patients who are discharged with a statin prescription must have their lipid levels monitored within 1 to 2 months of initiating treatment.

Patients who have been discharged while on a high-intensity statin regimen may not necessarily require long-term continuation of such an intensive statin therapy. Nevertheless, research findings indicate that patients tend to exhibit higher levels of treatment adherence when they follow the medication regimen prescribed at the time of their discharge [15]. Good adherence to recommended lipid-lowering therapy can be achieved with early and timely follow-up outpatient visits with proper and timely lipid testing[16,17]. Results of a study by Cannon *et al*[18] have shown significant reductions in CVD when statin is combined to ezetimibe to reduce LDL-C levels. Similarly combination of PCSK9 inhibitors to statin in order to reduce the LDL-C levels leads to significant reduction in LDL-C levels[19-21].

Another concerning finding is the history of hospital admissions in the past 12 months, reported by 14.4% of the patients. Even more alarming is that the readmission rate was significantly higher among non-compliant patients (37.5% *vs* 5.6%). This observation highlights the potential consequences of non-compliance with statin therapy. Patients who do not adhere to their prescribed medications may be at higher risk of recurrent cardiovascular events, necessitating hospitalization. In line with this, our study also revealed a significantly higher subsequent AMI event rate among non-compliant patients (43.8% *vs* 11.7%).

It is important to practice lipid testing with early sensitization, and follow guideline-recommended LDL-C targets, lipid lowering therapy optimization, proper lipid monitoring, and after a cardiovascular event with regular follow-up. In our study, we have not observed a single patients on combination therapy, this high-CV risk population that would benefit from a reduction in their high future cardiovascular risk as a result of the LDL-C reduction can be achieved with combination therapy. Shortly, we recommend combination of tolerable highest statin dose with other non-statin lipid-lowering drug for those patients who could not achieve target goal.

The small sample size in our study introduced limitations, as we only included patients who visited the cardiac risk assessment clinic for secondary prevention, potentially introducing selection bias. Larger studies, involving patients recruited from ACS settings, are needed to comprehensively assess lipid management in MI patients.

CONCLUSION

Our study is among the first to conduct a study on dyslipidemia management in post-MI patients in Pakistan. This study underscores the importance of comprehensive lipid profile management in post-AMI patients. While many patients are prescribed and are compliant with statin therapy, achieving target lipid levels remains a challenge. The association between non-compliance and higher hospitalization and subsequent AMI rates underscores the need for interventions to improve medication adherence in this vulnerable population.

However, there were gaps in post MI lipid profile in hospitalized patients, awareness of getting lipid profile before and after cardiovascular event, delays in post-discharge lipid testing and suboptimal achievement of the LDL-C goals. Underutilization of non-statin lipid-lowering therapy amongst those who needed optimization, highlighting some gaps in the secondary prevention of patients with previous MI as recommended by the 2021 ESC guidelines for CVD prevention. Further research and interventions in this area are warranted to reduce the burden of recurrent cardiovascular events in this population.

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REFERENCES

1 **World Heart Federation**. Deaths from cardiovascular disease surged 60% globally over the last 30 years: Report. 2023. Available from: https://world-heart-federation.org/news/deaths-from-cardiovascular-disease-surged-60-globally-over-the-last-30-years-report/
2 **Prospective Studies Collaboration**, Lewington S, Whitlock G, Clarke R, Sherliker P, Emberson J, Halsey J, Qizilbash N, Peto R, Collins R. Blood cholesterol and vascular mortality by age, sex, and blood pressure: a meta-analysis of individual data from 61 prospective studies with 55,000 vascular deaths. *Lancet* 2007; **370**: 1829-1839 [PMID: 18061058 DOI: 10.1016/S0140-6736(07)61778-4]
3 **Heart Protection Study Collaborative Group**. MRC/BHF Heart Protection Study of antioxidant vitamin supplementation in 20,536 high-risk individuals: a randomised placebo-controlled trial. *Lancet* 2002; **360**: 23-33 [PMID: 12114037 DOI: 10.1016/S0140-6736(02)09328-5]
4 **Cannon CP**, Steinberg BA, Murphy SA, Mega JL, Braunwald E. Meta-analysis of cardiovascular outcomes trials comparing intensive versus moderate statin therapy. *J Am Coll Cardiol* 2006; **48**: 438-445 [PMID: 16875966 DOI: 10.1016/j.jacc.2006.04.070]
5 **Cholesterol Treatment Trialists' (CTT) Collaboration**, Baigent C, Blackwell L, Emberson J, Holland LE, Reith C, Bhala N, Peto R, Barnes EH, Keech A, Simes J, Collins R. 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**: 1670-1681 [PMID: 21067804 DOI: 10.1016/S0140-6736(10)61350-5]
6 **Boekholdt SM**, Hovingh GK, Mora S, Arsenault BJ, Amarenco P, Pedersen TR, LaRosa JC, Waters DD, DeMicco DA, Simes RJ, Keech AC, Colquhoun D, Hitman GA, Betteridge DJ, Clearfield MB, Downs JR, Colhoun HM, Gotto AM Jr, Ridker PM, Grundy SM, Kastelein JJ. Very low levels of atherogenic lipoproteins and the risk for cardiovascular events: a meta-analysis of statin trials. *J Am Coll Cardiol* 2014; **64**: 485-494 [PMID: 25082583 DOI: 10.1016/j.jacc.2014.02.615]
7 **Mach F**, Baigent C, Catapano AL, Koskinas KC, Casula M, Badimon L, Chapman MJ, De Backer GG, Delgado V, Ference BA, Graham IM, Halliday A, Landmesser U, Mihaylova B, Pedersen TR, Riccardi G, Richter DJ, Sabatine MS, Taskinen MR, Tokgozoglu L, Wiklund O; ESC Scientific Document Group. 2019 ESC/EAS Guidelines for the management of dyslipidaemias: lipid modification to reduce cardiovascular risk. *Eur Heart J* 2020; **41**: 111-188 [PMID: 31504418 DOI: 10.1093/eurheartj/ehz455]
8 Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III). *JAMA* 2001; **285**: 2486-2497 [PMID: 11368702 DOI: 10.1001/jama.285.19.2486]
9 **Pedersen TR**, Faergeman O, Kastelein JJ, Olsson AG, Tikkanen MJ, Holme I, Larsen ML, Bendiksen FS, Lindahl C, Szarek M, Tsai J; Incremental Decrease in End Points Through Aggressive Lipid Lowering (IDEAL) Study Group. High-dose atorvastatin vs usual-dose simvastatin for secondary prevention after myocardial infarction: the IDEAL study: a randomized controlled trial. *JAMA* 2005; **294**: 2437-2445 [PMID: 16287954 DOI: 10.1001/jama.294.19.2437]
10 **Study of the Effectiveness of Additional Reductions in Cholesterol and Homocysteine (SEARCH) Collaborative Group**, Armitage J, Bowman L, Wallendszus K, Bulbulia R, Rahimi K, Haynes R, Parish S, Peto R, Collins R. Intensive lowering of LDL cholesterol with 80 mg versus 20 mg simvastatin daily in 12,064 survivors of myocardial infarction: a double-blind randomised trial. *Lancet* 2010; **376**: 1658-1669 [PMID: 21067805 DOI: 10.1016/S0140-6736(10)60310-8]
11 **Bezafibrate Infarction Prevention (BIP) study**. Secondary prevention by raising HDL cholesterol and reducing triglycerides in patients with coronary artery disease. *Circulation* 2000; **102**: 21-27 [PMID: 10880410 DOI: 10.1161/01.cir.102.1.21]
12 **Ference BA**, Ginsberg HN, Graham I, Ray KK, Packard CJ, Bruckert E, Hegele RA, Krauss RM, Raal FJ, Schunkert H, Watts GF, Borén J, Fazio S, Horton JD, Masana L, Nicholls SJ, Nordestgaard BG, van de Sluis B, Taskinen MR, Tokgözoglu L, Landmesser U, Laufs U, Wiklund O, Stock JK, Chapman MJ, Catapano AL. Low-density lipoproteins cause atherosclerotic cardiovascular disease. 1. Evidence from genetic, epidemiologic, and clinical studies. A consensus statement from the European Atherosclerosis Society Consensus Panel. *Eur Heart J* 2017; **38**: 2459-2472 [PMID: 28444290 DOI: 10.1093/eurheartj/ehx144]
13 **Cholesterol Treatment Trialists' (CTT) Collaborators**, Mihaylova B, Emberson J, Blackwell L, Keech A, Simes J, Barnes EH, Voysey M, Gray A, Collins R, Baigent C. 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**: 581-590 [PMID: 22607822 DOI: 10.1016/S0140-6736(12)60367-5]
14 **Visseren FLJ**, Mach F, Smulders YM, Carballo D, Koskinas KC, Bäck M, Benetos A, Biffi A, Boavida JM, Capodanno D, Cosyns B, Crawford C, Davos CH, Desormais I, Di Angelantonio E, Franco OH, Halvorsen S, Hobbs FDR, Hollander M, Jankowska EA, Michal M, Sacco S, Sattar N, Tokgozoglu L, Tonstad S, Tsioufis KP, van Dis I, van Gelder IC, Wanner C, Williams B; ESC Scientific Document Group. 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice. *Eur J Prev Cardiol* 2022; **29**: 5-115 [PMID: 34558602 DOI:

10.1093/eurjpc/zwab154]

15 **Nieuwlaat R**, Wilczynski N, Navarro T, Hobson N, Jeffery R, Keepanasseril A, Agoritsas T, Mistry N, Iorio A, Jack S, Sivaramalingam B, Iserman E, Mustafa RA, Jedraszewski D, Cotoi C, Haynes RB. Interventions for enhancing medication adherence. *Cochrane Database Syst Rev* 2014; **2014**: CD000011 [PMID: 25412402 DOI: 10.1002/14651858.CD000011.pub4]

16 **Benner JS**, Tierce JC, Ballantyne CM, Prasad C, Bullano MF, Willey VJ, Erbey J, Sugano DS. Follow-up lipid tests and physician visits are associated with improved adherence to statin therapy. *Pharmacoeconomics* 2004; **22** Suppl 3: 13-23 [PMID: 15669150 DOI: 10.2165/00019053-200422003-00003]

17 **Faridi KF**, Peterson ED, McCoy LA, Thomas L, Enriquez J, Wang TY. Timing of First Postdischarge Follow-up and Medication Adherence After Acute Myocardial Infarction. *JAMA Cardiol* 2016; **1**: 147-155 [PMID: 27437885 DOI: 10.1001/jamacardio.2016.0001]

18 **Cannon CP**, Blazing MA, Giugliano RP, McCagg A, White JA, Theroux P, Darius H, Lewis BS, Ophuis TO, Jukema JW, De Ferrari GM, Ruzyllo W, De Lucca P, Im K, Bohula EA, Reist C, Wiviott SD, Tershakovec AM, Musliner TA, Braunwald E, Califf RM; IMPROVE-IT Investigators. Ezetimibe Added to Statin Therapy after Acute Coronary Syndromes. *N Engl J Med* 2015; **372**: 2387-2397 [PMID: 26039521 DOI: 10.1056/NEJMoa1410489]

19 **Robinson JG**, Farnier M, Krempf M, Bergeron J, Luc G, Averna M, Stroes ES, Langslet G, Raal FJ, El Shahawy M, Koren MJ, Lepor NE, Lorenzato C, Pordy R, Chaudhari U, Kastelein JJ; ODYSSEY LONG TERM Investigators. Efficacy and safety of alirocumab in reducing lipids and cardiovascular events. *N Engl J Med* 2015; **372**: 1489-1499 [PMID: 25773378 DOI: 10.1056/NEJMoa1501031]

20 **Colhoun HM**, Robinson JG, Farnier M, Cariou B, Blom D, Kereiakes DJ, Lorenzato C, Pordy R, Chaudhari U. Efficacy and safety of alirocumab, a fully human PCSK9 monoclonal antibody, in high cardiovascular risk patients with poorly controlled hypercholesterolemia on maximally tolerated doses of statins: rationale and design of the ODYSSEY COMBO I and II trials. *BMC Cardiovasc Disord* 2014; **14**: 121 [PMID: 25240705 DOI: 10.1186/1471-2261-14-121]

21 **Sabatine MS**, Giugliano RP, Keech A, Honarpour N, Wang H, Liu T, Wasserman SM, Scott R, Sever PS, Pedersen TR. Rationale and design of the Further cardiovascular OUtcomes Research with PCSK9 Inhibition in subjects with Elevated Risk trial. *Am Heart J* 2016; **173**: 94-101 [PMID: 26920601 DOI: 10.1016/j.ahj.2015.11.015]

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