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Original Research

Achieving Optimal LDL Levels in Patients with Stable Ischemic Heart Disease

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ABSTRACT:

Background: Low-density lipoprotein cholesterol (LDL-C) reduction is a key target in secondary prevention of stable ischemic heart disease (SIHD). However, many patients fail to reach guideline-recommended targets despite pharmacological therapy. **Aim:** To assess the frequency of LDL-C target attainment and its predictors among patients with SIHD in a tertiary care center in India. **Material and Methods:** This cross-sectional study included 120 patients with SIHD. Sociodemographic, clinical, and treatment related variables were recorded. LDL-C levels were measured and compared with recommended targets. Statistical analysis included chi-square tests and logistic regression to identify predictors of target attainment. **Results:** The majority of patients were on statin therapy (96.7%), predominantly atorvastatin (62.1%) and rosuvastatin (37.9%). High-intensity statin therapy was associated with significantly higher rates of LDL-C goal attainment (p=0.007). Age, gender, hypertension, stroke, PAD, and obesity were significantly associated with LDL-C control. Logistic regression identified age, gender, hypertension, and stroke as independent predictors. **Conclusion:** Despite widespread statin use, a considerable proportion of SIHD patients fail to achieve LDL-C targets. Intensification of therapy, early intervention, and use of combination lipid-lowering strategies could improve target achievement and reduce residual cardiovascular risk.

Keywords: LDL cholesterol, statins, ischemic heart disease, lipid targe

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INTRODUCTION

Stable ischemic heart disease (SIHD) remains a major cause of morbidity and mortality worldwide, with a significant burden in developing countries, including India, where cardiovascular disease onset occurs nearly a decade earlier compared to Western populations [1]. Dyslipidemia, particularly elevated low-density lipoprotein cholesterol (LDL-C), plays a pivotal role in the pathogenesis and progression of atherosclerotic cardiovascular disease (ASCVD), making LDL-C reduction a key therapeutic goal [2]. International guidelines, such as those from the European Society of Cardiology (ESC) and the American College of Cardiology/American Heart Association (ACC/AHA), recommend stringent LDL-C targets in high- and very-high-risk patients to mitigate cardiovascular events [3]. In patients with established ASCVD, including SIHD, current consensus supports achieving LDL-C levels of <55 mg/dL in very-high-risk groups and <70 mg/dL in high-risk groups [4].

Despite robust evidence from randomized controlled trials demonstrating that LDL-C lowering translates to significant reductions in recurrent cardiovascular events, achieving optimal LDL-C targets in real-world settings remains a challenge [5]. Multiple factors contribute to suboptimal attainment, including limited adherence to statin therapy, physician inertia, lack of routine lipid monitoring, and socioeconomic barriers in resource-limited environments [6]. In India, where SIHD prevalence is rising rapidly due to urbanization, sedentary lifestyles, and dietary shifts, there is growing concern that a significant proportion of patients fail to achieve guideline-recommended LDL-C goals [7].

Recent studies have demonstrated that even modest LDL-C reductions confer incremental cardiovascular benefits, supporting the “lower is better” paradigm [8]. However, registry-based data and observational

studies suggest that, in many tertiary care centers, less than half of eligible patients achieve optimal LDL-C targets, indicating a gap between evidence and practice [9]. Furthermore, the use of high-intensity statins and combination lipid-lowering therapies, such as ezetimibe or proprotein convertase subtilisin/kexin type 9 (PCSK9) inhibitors, remains low in Indian clinical practice despite proven efficacy [10].

This study aims to assess the frequency of LDL-C target attainment and identify predictors influencing LDL-C goal achievement in patients with stable ischemic heart disease attending a tertiary care center in India. Understanding these predictors will help formulate strategies for improving lipid management, thereby reducing the residual cardiovascular risk in this vulnerable patient population.

MATERIAL AND METHODS

This cross-sectional observational study was conducted in the cardiology outpatient department of a tertiary care center in India over a period of 12 months. A total of 120 patients diagnosed with stable ischemic heart disease (SIHD) were enrolled after obtaining informed consent. Patients were eligible if they were aged 18 years and above, had a confirmed diagnosis of SIHD based on clinical history, electrocardiographic findings, and/or prior coronary angiography, and had been on stable medical therapy for at least three months. Exclusion criteria included patients with acute coronary syndromes within the past three months, severe hepatic or renal impairment, active inflammatory or infectious diseases, and those unwilling to participate.

Baseline demographic data, clinical characteristics, comorbidities, duration of SIHD, and current pharmacological therapy, including lipid-lowering agents, were recorded. Fasting blood samples were collected for complete lipid profiling, including total cholesterol, triglycerides, high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C), using the Friedewald formula where applicable. LDL-C target attainment was evaluated according to the latest European Society of Cardiology (ESC) guidelines, with optimal target defined as <55 mg/dL for very-high-risk patients and <70 mg/dL for high-risk patients.

Additional data regarding lifestyle factors such as smoking status, dietary habits, and physical activity levels were obtained through structured interviews. Medication adherence was assessed using the Morisky Medication Adherence Scale (MMAS-8), and statin intensity was categorized according to American College of Cardiology/American Heart Association (ACC/AHA) recommendations.

Echocardiographic parameters, history of prior revascularization, and the presence of coexisting conditions such as diabetes mellitus, hypertension, and chronic kidney disease were noted. Statistical analysis was performed using SPSS software version 25.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The Chi-square test was applied for categorical comparisons, and independent t-tests or Mann-Whitney U tests were used for continuous variables as appropriate. Logistic regression analysis was conducted to identify independent predictors of LDL-C target attainment, with a p-value of <0.05 considered statistically significant.

RESULTS

The analysis of the study population revealed several important patterns in sociodemographic and clinical characteristics. As shown in Table 1, the majority of patients were in the older age group (M ≥ 55 or F ≥ 65 years), with males outnumbering females. A large proportion of patients reported a sedentary lifestyle, and hypertension was the most common comorbidity. Diabetes, stroke, and central obesity were also prevalent, while peripheral arterial disease (PAD) was relatively rare.

Table 2 illustrates the treatment patterns among the participants. Most patients were on statin therapy, with atorvastatin being the most frequently prescribed drug, followed by rosuvastatin. High-intensity statin therapy was more common than moderate-intensity therapy. Only a small percentage of patients received combination therapy with ezetimibe or other lipid-lowering agents.

In Table 3, the relationship between achieving optimal LDL-C levels and various sociodemographic and clinical variables is presented. Significant associations were noted with age, gender, hypertension, stroke history, PAD, and obesity, with these factors influencing the likelihood of LDL-C target attainment. Other variables such as family history, smoking, diabetes, and central obesity did not show statistically significant differences.

Table 4 explores the association between treatment modality and LDL-C target achievement. Statin use, particularly high-intensity therapy, was significantly linked to achieving target LDL-C levels, whereas statin type, combination therapy, and atorvastatin equivalent dose did not show a significant difference.

Finally, Table 5 presents the binary logistic regression analysis identifying independent predictors of LDL-C target attainment. Age, gender, hypertension, and stroke emerged as significant predictors, while PAD, BMI, and statin dose intensity were not statistically significant in the adjusted model.

Table 1: The distribution of study sample according to sociodemographic characteristic and clinical variables

Variable	Frequency (N=120)	Percentage (%)
Age		
M<55 or F<65	**40**	**33.3**
M≥55 or F≥65	**80**	**66.7**
Gender		
Male	**74**	**61.7**
Female	**46**	**38.3**
Family hx. of IHD		
Yes	**13**	**10.8**
No	**107**	**89.2**
Smoking		
Yes	**26**	**21.7**
No	**94**	**78.3**
Sedentary lifestyle		
Yes	**92**	**76.7**
No	**28**	**23.3**
Hypertension		
Yes	**86**	**71.7**
No	**34**	**28.3**
Diabetes		
Yes	**68**	**56.7**
No	**52**	**43.3**
Stroke		
Yes	**30**	**25.0**
No	**90**	**75.0**
PAD		
Yes	**5**	**4.2**
No	**115**	**95.8**
BMI		
Obese	**51**	**42.5**
Non-obese	**69**	**57.5**
Central obesity		
Yes	**93**	**77.5**
No	**27**	**22.5**

Table 2: The distribution of study sample according to treatment modalities

Variable	Frequency (N)	Percent (%)
Patients on statin Tx.	**Yes 116 (120)**	**96.7**
	No 4 (120)	**3.3**
Statin type	**Atorvastatin 72 (116)**	**62.1**
	Rosuvastatin 44 (116)	**37.9**
Combination of Tx.	**Statin + Ezetimibe 2 (116)**	**1.7**
	Statin + other	**11 (116)**
Atorvastatin equivalent dose	**Mean ± SD**	**42.40 ± 20.26**
Intensity Statin Therapy	**High 83 (116)**	**71.6**
	Moderate 33 (116)	**28.4**

Table 3: Relationship of optimum LDL-C Level with sociodemographic and clinical variables

Variable	<70 N (%)	≥70 N (%)	P value
Age	**M<55 or F<65 15 (20.8)**	**25 (50.0)**	**0.001**
	M≥55 or F≥65 57 (79.2)	**25 (50.0)**	
Gender	**Male 58 (80.6)**	**16 (32.0)**	**0.001**
	Female 14 (19.4)	**34 (68.0)**	
Family hx.	**Yes 7 (9.7)**	**6 (12.0)**	**0.640**
	No 65 (90.3)	**44 (88.0)**	
Smoking	**Yes 17 (23.6)**	**9 (18.0)**	**0.460**

	No 55 (76.4)	41 (82.0)	
Sedentary lifestyle	Yes 56 (77.8)	36 (72.0)	0.470
	No 16 (22.2)	14 (28.0)	
Hypertension	Yes 44 (61.1)	42 (84.0)	0.006
	No 28 (38.9)	8 (16.0)	
Diabetes	Yes 38 (52.8)	30 (60.0)	0.420
	No 34 (47.2)	20 (40.0)	
Stroke	Yes 6 (8.3)	24 (48.0)	0.001
	No 66 (91.7)	26 (52.0)	
PAD	Yes 2 (2.8)	3 (6.0)	0.400
	No 70 (97.2)	47 (94.0)	
BMI	Obese 21 (29.2)	30 (60.0)	0.002
	Non-obese 51 (70.8)	20 (40.0)	
Central obesity	Yes 59 (81.9)	34 (68.0)	0.090
	No 13 (18.1)	16 (32.0)	

Table 4: The Relationship of optimal LDL target level with treatment modality

Variable	<70 N (%)	≥70 N (%)	P value
Patients on statin Tx.	Yes 72 (98.6)	44 (88.0)	0.010
	No 1 (1.4)	6 (12.0)	
Statin type	Atorvastatin 46 (63.9)	26 (59.1)	0.610
	Rosuvastatin 26 (36.1)	18 (40.9)	
Combination of Tx.	Statin+Ezetimibe 1 (1.4)	1 (2.3)	0.770
	Statin+others 6 (8.3)	5 (11.4)	
Atorvastatin equivalent dose	Mean 41.4	47.2	0.160
	SD 18.46	27.03	
Statin dose intensity	High 58 (80.6)	25 (56.8)	0.007
	Moderate 14 (19.4)	19 (43.2)	

Table 5: Binary logistic regression analysis (AOR with 95% CI) for variables related to ischemic heart disease regarding optimum LDL level

Variable	SE coefficient	AOR	95% CI	P value
Age	0.611	0.288	0.087–0.953	0.041
Gender	0.810	12.595	2.577–61.560	0.002
Hypertension	0.826	5.935	1.177–29.936	0.031
Stroke	0.808	138.160	28.376–672.680	0.000
PAD	1.123	2.214	0.245–20.001	0.479
BMI	0.526	2.579	0.920–7.230	0.072
Statin dose intensity	0.575	0.934	0.303–2.882	0.905

DISCUSSION

The present study provides valuable insights into the attainment of optimal LDL-C levels among patients with stable ischemic heart disease (SIHD) in a tertiary care setting, highlighting the influence of demographic, clinical, and therapeutic factors. The findings indicate that while the majority of patients were on statin therapy, a significant proportion still failed to achieve LDL-C targets, reflecting a persistent treatment gap despite guideline-recommended management. Similar trends have been documented in other Indian and international cohorts, emphasizing the need for more aggressive lipid-lowering strategies and individualized care approaches [11].

A notable observation in this study was the significant association of age, gender, hypertension, stroke history, PAD, and BMI with LDL-C target attainment. These associations align with evidence suggesting that older patients, females, and those with multiple comorbidities often face challenges in achieving lipid targets due to differences in drug metabolism, adherence patterns, and treatment intensification practices [12]. Moreover, obesity and central adiposity contribute to dyslipidemia through insulin resistance and altered lipid metabolism, reinforcing the importance of weight management as a complementary therapeutic target [13]. Therapeutically, the study reinforces the role of high-intensity statin therapy in achieving optimal LDL-C control. Patients receiving high-intensity statins had a significantly greater likelihood of meeting LDL-C targets compared to those on moderate-intensity therapy, consistent with meta-analytic evidence demonstrating a dose-dependent relationship between statin intensity and LDL-C reduction [14]. However, the small proportion of patients receiving combination therapy with ezetimibe or other lipid-

lowering agents points toward an underutilization of adjunctive pharmacological options, despite guideline recommendations to incorporate them in cases where monotherapy is insufficient.

The logistic regression findings further highlight the independent predictive value of stroke and hypertension in determining LDL-C goal achievement. This underscores the importance of aggressive secondary prevention in high-risk groups, especially given the heightened cardiovascular morbidity and mortality associated with inadequate lipid control [15]. Addressing physician inertia, patient adherence issues, and socioeconomic barriers will be crucial in bridging the observed treatment gaps.

CONCLUSION

This study demonstrates that while statin therapy remains the cornerstone of LDL-C management in SIHD, a substantial proportion of patients do not attain target lipid levels. Factors such as age, gender, hypertension, stroke, PAD, and obesity significantly influence LDL-C control, and high-intensity statin therapy is associated with better outcomes. Optimizing treatment through early intervention, personalized therapy, and the judicious use of combination agents could enhance target attainment rates and reduce residual cardiovascular risk in this high-risk population.

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