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The therapeutic effect of PCSK9 inhibitors on dyslipidemia: one-year follow up

Maryam Moshkani Farahani,[1] Alireza Nasiri,[1] Mahdi Salari,[2] Ali Shamsedini[1]

[1]*Atherosclerosis Research Center, Baqiayatallah University of Medical Sciences, Tehran, Iran;* [2]*Shafa Cardiovascular Medical and Research Center, Kerman University of Medical Sciences, Kemran, Iran.*

Abstract

Despite the availability of statins and lifestyle modifications, many patients with Dyslipidemia struggle to achieve optimal low-density lipoprotein cholesterol (LDL-C) control. PCSK9 inhibitors offer a promising new therapeutic option with superior LDL-C lowering efficacy compared to statins. However, data on their real-world use, particularly in Iran, is limited. This study aims to address this gap by investigating the one-year effects of evolocumab on lipid profiles and potential cardiovascular outcomes in Iranian patients with Familial Hypercholesterolemia (FH).This single-center, prospective study evaluated evolocumab effectiveness in lowering LDL-C in 50 Iranian adults with FH. Participants with a documented LDL-C >190 mg/dL on existing cholesterol medications (excluding PCSK9 inhibitors) and a clinical FH diagnosis was included. After baseline assessments (medical history, demographics, lipid profile), evolocumab was administered subcutaneously every two weeks for one year. Follow-up assessments at year one measured changes in LDL-C, high-density lipoprotein cholesterol (HDL-C), and triglycerides. The study enrolled 50 participants with an average age of 55 years old (range 35-80 years). Treatment with evolocumab led to significant improvements in lipid profiles at all follow-up points compared to baseline. On average, LDL-C levels decreased by 105.24 mg/dL, triglycerides decreased by 59.20 mg/dL, and HDL-C levels increased by a modest but significant 4.5 mg/dL after one year($p<0.001$). Subgroup analysis revealed no statistically significant interactions between baseline demographics (age, sex, BMI) or lifestyle habits (smoking, alcohol) and changes in lipid levels($p>0.05$). However, a significant interaction emerged between baseline lipid levels and their corresponding reductions, suggesting greater improvement in patients with higher baseline values($p<0.05$). It is noteworthy that no new cardiovascular events were reported during the study period. This study demonstrates the effectiveness of evolocumab in improving lipid profiles in Iranian patients with FH. The observed reductions in LDL-C and triglycerides, along with a modest increase in HDL-C, suggest potential benefits for cardiovascular risk reduction. The absence of new cardiovascular events during the study is encouraging, but further research with larger and longer-term follow-up is needed to confirm these findings and assess the long-term safety and impact on quality of life.

Key Words: dyslipidemia; hypercholesterolemia; PCSK9 inhibitors; lipid profile; cardiovascular disease.

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Familial Hypercholesterolemia (FH), an autosomal dominant genetic disorder, causes high levels of Low-Density Lipoprotein Cholesterol (LDL-C) due to mutations in genes controlling cholesterol regulation. The most common mutation affects the LDLR gene, responsible for building LDL receptors that remove LDL cholesterol from the blood.[1] These mutations hinder LDL receptor function or production. While LDLR mutations are most frequent, abnormalities in APOB, LDLRAP1, and PCSK9 genes can also contribute to FH. PCSK9, a liver-secreted serine protease, plays a crucial role by regulating LDL cholesterol levels. Its binding to LDL

receptors triggers their degradation, reducing LDL-C clearance from the bloodstream.[2,3] Not all cases will have a clear genetic cause, and some may involve a combination of factors.[4,6]

Early diagnosis and treatment of FH are crucial to significantly reduce the risk of developing CHD and other cardiovascular problems. Despite the well-established benefits, screening rates for FH remain low, leading to suboptimal management in this patient population. Due to the high prevalence of FH, widespread screening is essential to identify affected individuals and their relatives. This allows for appropriate genetic evaluation and management to be initiated promptly. Screening can be done simply by measuring LDL-C levels, making it a cost-effective approach.

Effective FH screening programs require healthcare providers' familiarity with FH diagnostic criteria, particularly the widely accepted Simon Broome criteria. These criteria consider factors like LDL-C levels, family history of premature coronary heart disease, and physical signs like tendon xanthomas and corneal arcus.[7] Genetic testing complements this approach by enabling the identification of disease-causing mutations in the LDL receptor, APOB, and PCSK9 genes. This method is considered the gold standard for definitive FH diagnosis and is particularly useful when clinical criteria are inconclusive or when there is a strong family history of FH.[8,12,13]

PCSK9 inhibitors, such as evolocumab and alirocumab, are monoclonal antibodies that lower LDL-C levels by blocking the PCSK9 protein. PCSK9 normally binds to LDL receptors on liver cells, promoting their degradation and hindering LDL-C clearance from the bloodstream. Blocking this interaction leads to an increase in functional LDLRs on the liver surface, enhancing LDL-C uptake and removal, ultimately resulting in lower LDL-C levels.[9,10] Approved for FH management in various countries, including the United States,[11] PCSK9 inhibitors offer a valuable therapeutic option for patients who struggle to achieve optimal LDL-C control with traditional therapies. Studies have shown significant reductions (50-60%) in LDL-C levels for patients with HeFH.[6,12,13] However, the effectiveness is less pronounced in patients with HoFH, especially those with minimal residual LDLR activity.[14]

Despite promising evidence for PCSK9 inhibitors, data on their real-world use, particularly at the national level and for long-term effects in Iranian patients with dyslipidemia, remains limited. This knowledge gap hinders understanding of how effectively these medications reach high-risk patients and their long-term impact in countries like Iran. This study aims to address these limitations by investigating the one-year effects of PCSK9 inhibitor therapy on lipid levels, cardiovascular events, and quality of life in Iranian patients with FH. By examining both the national-level implications of PCSK9 inhibitor recommendations and the long-term effects in Iranian patients, this research has the potential to significantly contribute to improving dyslipidemiamanagement in Iran. This comprehensive approach can provide valuable insights for physicians, ultimately ensuring these therapies reach those who can benefit most and improve clinical practice and patient care for dyslipidemia management in Iran.

Materials and Methods

Study design and participants

This was a single-center, prospective, one-year follow-up study evaluating the efficacy of Evolocumab in lowering LDL-C levels in patients with dyslipidemia diagnosed with FH. Fifty participants over 18 years of age were selected. Inclusion criteria consisted of documented LDL-C levels exceeding 190 mg/dL on a stable regimen of cholesterol-lowering medications (excluding PCSK9 inhibitors) and a clinical diagnosis of FH based on established criteria (Based on physical examination, previous history of FH and assessment of LDL-C level in blood). Patients with underlying medical conditions that could confound the study results were excluded. Additionally, participants with incomplete medical records were not included. Informed consent was obtained from all participants, and the study adhered to ethical guidelines for patient confidentiality.

Baseline assessment and intervention

Prior to initiating Evolocumab therapy, all participants underwent a comprehensive clinical examination. Demographic data, medical history, including cardiovascular events (Myocardial Infarction (MI), Percutaneous Coronary Intervention (PCI), Coronary Artery Bypass Grafting (CABG), Peripheral Artery Disease(PAD), vascular involvement), history of angiography, diabetes, and prior hospitalization in the coronary care unit (CCU), were documented. Blood samples were collected to measure baseline levels of LDL-C, HDL-C, and triglycerides.

Evolocumab was administered subcutaneously at a standard dose (140 mg/ml) with a two-week interval for one year. After one year of treatment, participants returned for a follow-up clinical examination. Blood samples were again collected to assess changes in LDL-C, HDL-C, and triglyceride levels.

Statistical analysis

At the inferential level to control the presumption of data normality the Shapiro-Wilk test was used; if this assumption was established, the test One-way ANOVA along with Bonferroni's post hoc test and otherwise Kruskal-Wallis and Mann-Whitney test were performed. To compare the qualitative variables between patients with different severity of the disease chi-square or Fisher's exact test was used. Analyzes was performed at the 5% error level using SPSS software version 24.

Results

Baseline demographics and lifestyle habits

The study enrolled 50 participants with an average age of 55 years old (range 35-80 years). The group was predominantly male, with 35 males (70%), 15 females (30%), and with an average body mass index (BMI) of 25.5 (range

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19.8-30.8). In terms of lifestyle habits, 8 participants (16%) reported smoking and 5 participants (10%) reported occasional alcohol consumption (Table 1).

Cardiovascular history

The study population had a moderate average Left Ventricular Ejection Fraction (LVEF) of 51.32%. However, there was heterogeneity within the group, with 24 patients (48%) having a low LVEF (mean: 47.29%) and 26 patients (52%) having a normal LVEF (mean: 55.04%). In terms of prior cardiovascular events (CVD), 13 patients (26%) had a history of MI, 10 patients (20%) had undergone PCI, 3 patients (6%) had received CABG, and 4 patients (8%) had PAD. The average vessel involvement in patients with PAD was 1.8. Importantly, none of these patients experienced new cardiovascular events during the one-year follow-up period. Additionally, 16 patients (32%) within the study population were diagnosed with diabetes mellitus (Table 2).

Baseline medication

Baseline medication use revealed that statins were the most common cholesterol-lowering therapy, with 42 patients (84%) receiving medications like atorvastatin and rosuvastatin. Among these statin users, 7 patients (17%) also received ezetimibe for additional LDL-C reduction. Fibrates (fenofibrate and gemfibrozil) were used by a smaller proportion of patients (5 out of 50, 10%), with 2 of them (40%) also taking ezetimibe. Only 1 patient (2%) received both statins and fibrates concurrently. Notably, 2 patients (4%) did not receive medication specifically for LDL-C control but were taking anti-platelet drugs and beta-blockers, likely for other cardiovascular conditions. Regarding prior procedures, 25 patients (50%) had undergone angiography before entering the study, and 23 patients (46%) had a prior admission to the CCU. Importantly, no new occurrences of these procedures were observed during the one-year follow-up period.

Table 1. *Baseline Demographics and Lifestyle Habits of Study Participants with Familial Hypercholesterolemia (n=50).*

Variables	N	%	Mean	Range	SD
Gender					
Male	35	70.0			
Female	15	30.0			
Smoker	8	16.0			
Alcohol use	5	10.0			
Age		55.38	35-80	11.62	
BMI index			25.52	19.8-30.8	2.37

Table 2. *Baseline cardiovascular parameters (n=50).*

	Count	Mean	SD	Count	Column N %
Ejection fraction					
Low	24	47.29	3.61		
Normal	26	55.04	0.20		
Vascular involvement					
None				29	58.0
1				8	16.0
2				9	18.0
3				4	8.0

Evolocumab significantly improved lipid profile

At baseline, participants exhibited average triglyceride and LDL-C levels of 270.2±38.94 mg/dL and 227.7±28.84 mg/dL, respectively. Following one year of evolocumab treatment, these values demonstrated statistically significant reductions (p-values <0.001). Follow-up measurements revealed a decrease in triglycerides to an average of 210.8±34.75 mg/dL and a notable reduction in LDL-C to 122.5±22.80 mg/dL. Conversely, HDL-C levels displayed a statistically significant increase (p-value <0.001) from a baseline of 44.34±6.23 mg/dL to 48.84±5.81 mg/dL after one year. These findings provide strong evidence that evolocumab therapy effectively improved the overall lipid profile of study participants, potentially reducing their risk of cardiovascular events. (Tables 3 and 4).

Subgroup analysis and evolocumab efficacy

We investigated whether evolocumab's effectiveness varied based on patient characteristics by performing subgroup analysis and linear regression. These analyses explored potential influences of age, gender, smoking status, occasional alcohol consumption, and BMI. While evolocumab demonstrably improved lipid profiles overall, we did not observe any statistically significant interactions between these factors and changes in triglyceride, LDL-C, or HDL-C levels (p>0.05). In simpler terms, Evolocumab appeared to be equally effective in lowering LDL-C, increasing HDL-C, and reducing triglycerides regardless of a patient's age, gender, smoking status, occasional alcohol consumption, or BMI (Table 5).

We further investigated the influence of baseline lipid levels (LDL-C, triglycerides, and HDL-C) on evolocumab's efficacy. Interestingly, we observed statistically significant interactions. Patients with higher baseline lipid levels experienced a greater reduction in those specific lipids compared to those with lower baseline values. This suggests evolocumab may be particularly beneficial for individuals with more severe dyslipidemia (p<0.05) (Table 6).

Our analysis did not reveal any significant relationships between evolocumab efficacy and prior cardiovascular events (history of MI, PCI, CABG, PAD), presence of diabetes mellitus, or baseline medications (ezetimibe, fibrates, statins, anti-platelet drugs, and beta-blockers) (p>0.05).

Table 3. *Lipid profile at baseline and after evolocumab treatment (mg/dL; Mean±SE, Range).*

	Baseline lipid profile (mg/dL)			Lipid profile after treatment (mg/dL)		
	TG	LDL	HDL	TG	LDL	HDL
Mean	270.20	227.74	44.34	210.80	122.50	48.84
SE of mean	5.507	4.078	.881	4.914	3.224	.822
Median	270.00	230.00	46.00	200.00	120.00	50.00
SD	38.940	28.838	6.232	34.749	22.796	5.815
Range	200 200-400	110 190-300	25 30-55	180 140-320	110 80-190	22 38-60

Table 4. *Paired Samples T-test results: changes in triglycerides, LDL-C, and HDL-C after one-year evolocumab therapy (mg/dL)*

		Mean	SD	SE mean	95% CI of the difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	TG before and after treatment	59.400	25.747	3.641	52.083	66.717	16.314	49	.000
Pair 2	LDL before and after treatment	105.240	23.153	3.274	98.660	111.820	32.141	49	.000
Pair 3	HDL before and after treatment	-4.500	2.816	.398	-5.300	-3.700	-11.301	49	.000

Table 5. *Impact of demographics on changes in triglycerides, LDL-C, and HDL-C after evolocumab treatment: tests of between-subjects effects.*

Dependent variable	Source	Type III sum of squares	df	Mean square	F	Sig.
TG Change	Corrected model	14773.667[a]	27	547.173	0.680	0.831
	Intercept	95333.285	1	95333.285	118.438	0.000
	Gender	61.227	1	61.227	0.076	0.785
	Age	9834.108	22	447.005	0.555	0.912
	Gender * Age	3150.883	4	787.721	0.979	0.439
	Error	17708.333	22	804.924		
	Total	208900.000	50			
	Corrected total	32482.000	49			

a, R Squared = 0.455 (Adjusted R Squared = -0.214).

LDL Change	Corrected model	17438.037[a]	27	645.853	1.609	0.129
	Intercept	346988.435	1	346988.435	864.614	0.000
	Gender	4.890	1	4.890	0.012	0.913
	Age	16862.070	22	766.458	1.910	0.068
	Gender * Age	683.629	4	170.907	0.426	0.788
	Error	8829.083	22	401.322		
	Total	580040.000	50			
	Corrected total	26267.120	49			

a, R Squared = 0.455 (Adjusted R Squared = -0.214).

HDL Change	Corrected model	237.500[a]	27	8.796	1.282	0.278
	Intercept	665.027	1	665.027	96.891	0.000
	Gender	0.260	1	0.260	0.038	0.847
	Age	211.242	22	9.602	1.399	0.219
	Gender * Age	14.477	4	3.619	0.527	0.717
	Error	151.000	22	6.864		
	Total	1401.000	50			
	Corrected total	388.500	49			

a, R Squared = 0.611 (Adjusted R Squared = 0.134).

However, it is important to consider the limitations of a small sample size in this analysis as well. Future studies with larger and more diverse patient populations are needed to definitively assess the potential interactions between these factors and evolocumab's effectiveness.

Discussion

Our study aimed to assess the effectiveness of evolocumab in lowering LDL-C levels for patients with dyslipidemia. The findings demonstrated a significant improvement in the lipid profiles of participants following one year of evolocumab therapy. Treatment resulted in a substantial decrease in LDL-C by an average of 105.24±2315 mg/dL, bringing LDL-C levels closer to the recommended range of 50 to 100 mg/dL. Additionally, evolocumab treatment led to a notable reduction in triglycerides (average decrease of 59.40±25.74 mg/dL) and a modest, yet statistically significant, decreased in HDL-C (average of -4.5±2.81 mg/dL). These findings align with previous research highlighting evolocumab's efficacy in improving overall lipid profiles for patients with similar conditions.

Our findings regarding EVOLOCUMAB'S effectiveness in lowering LDL-C and improving overall lipid profiles are consistent with prior research on PCSK9 inhibitors for dyslipidemia management. The network meta-analysis by Toth *et al.* (2017) strengthens these findings by positioning evolocumab among the most effective non-statin therapies for LDL-C reduction.15 These observations are further supported by Rosenson *et al.* (2016), whose research indicates evolocumab's effectiveness in lowering LDL-C for patients with mixed hyperlipidemia.[16] Furthermore, Zhang *et al.* (2022) provide compelling data from a large-scale meta-analysis, demonstrating significant reductions in LDL-C, triglycerides, and ApoB with PCSK9 inhibitor use, particularly in high-risk cardiovascular patients.[17] Interestingly, their analysis also revealed an average increase in HDL-C of 6.27 mg/dL, aligning closely with the 4.5 mg/dL increase observed in our study. Taken together, these findings highlight evolocumab's potential as a valuable therapeutic tool for managing a broad spectrum of dyslipidemia, especially for those with high cardiovascular risk.

It's important to note that some studies have reported slightly higher or lower average reductions in LDL-C depending on factors like baseline LDL-C levels, treatment duration, and patient characteristics.[18] However, the overall consensus from prior research strongly supports the effectiveness of evolocumab and similar PCSK9 inhibitors in significantly improving lipid profiles.

Our investigation explored potential factors influencing evolocumab's efficacy. While we did not observe statistically significant interactions between demographics (age, sex, BMI) or occasional lifestyle habits (smoking, alcohol consumption) and changes in lipid levels, a different pattern

Table 6. *Linear regression analysis: predictors of changes in lipid profile after evolocumab treatment.*

Coefficients Dependent variable		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. error	Beta		
TG Change	(Constant)	24.134	46.024		0.524	0.603
	Baseline TG	-0.322	0.085	-0.487	-3.799	**0.000***
	Age	0.238	0.283	0.107	0.839	0.406
	BMI index	-0.383	1.393	-0.035	-0.275	0.785
LDL Change	(Constant)	34.651	43.904		0.789	0.434
	Baseline LDL	-.521	0.099	-0.648	-5.251	**0.000***
	Age	-0.020	0.244	-0.010	-0.084	0.934
	BMI index	-0.792	1.116	-0.081	-0.710	0.482
HDL Change	(Constant)	10.556	5.093		2.073	0.044
	Baseline HDL	-0.173	0.062	-0.384	-2.781	**0.008***
	Age	0.023	0.033	0.094	0.681	0.500
	BMI index	0.015	0.162	0.012	0.090	0.929

**significant.*

emerged when considering baseline lipid levels. There was a statistically significant interaction between baseline levels (LDL-C, triglycerides, HDL-C) and their corresponding changes after evolocumab treatment. This suggests that patients with higher baseline lipid levels experienced a greater reduction in those specific lipids compared to those with lower baseline values. This finding aligns with observations in some prior research.[19]

Evolocumab's mechanism of action, by inhibiting PCSK9 and promoting LDL-C clearance, likely contributes to the significant improvements in lipid profiles observed in our study.[20] This aligns with the growing recognition of PCSK9 inhibitors as a valuable therapeutic approach, particularly for high-risk patients like those with FH. As highlighted by Mohamed *et al.* (2023), statin monotherapy often falls short in achieving optimal LDL-C reduction for such patients.[21] PCSK9 inhibitors, as discussed in their review, offer a promising alternative with the potential to improve cardiovascular outcomes. Our findings on evolocumab's efficacy are further bolstered by research on other PCSK9 inhibitors. The Ginsberg *et al.* (2016) study with Alirocumab demonstrates positive outcomes in patients with FH despite maximized statin therapy.[22] This reinforces the effectiveness of this drug class in a population highly similar to our own, strengthening the generalizability of our observations to a broader range of high-risk FH patients. Together, these studies support the rationale behind our investigation – to explore alternative options for effectively managing LDL-C in high-risk individuals. Our study findings, combined with the existing body of research, provide compelling evidence for evolocumab's efficacy in improving lipid profiles in patients with FH, offering a valuable tool for managing dyslipidemia in this high-risk population.

Furthermore, evolocumab's impact may extend beyond simply lowering LDL-C. Although the exact mechanisms remain under investigation, some studies suggest evolocumab may indirectly influence HDL-C levels.23 This potential influence could involve stimulating HDL production or reducing its breakdown within the body, leading to the modest increase in HDL-C observed in our study (4.5 mg/dL). These combined effects of evolocumab on both LDL-C and HDL-C have the potential to translate into significant clinical benefits. A lower LDL-C level and a more favorable LDL-C to HDL-C ratio are well-established risk factors for atherosclerosis, the hardening and narrowing of arteries due to plaque buildup. Atherosclerosis is a major precursor to various cardiovascular events, including myocardial infarction and stroke. Therefore, evolocumab's capacity to improve both LDL-C and HDL-C holds promise for mitigating cardiovascular risk in patients with familial hypercholesterolemia.

Based on our results, it is noteworthy that a considerable proportion of the study population had a high cardiovascular risk burden, with approximately half (50%, n = 25) of the participants had undergone coronary angiography before study enrollment, and nearly half (46%, n = 23) had a documented prior admission to the Coronary Care Unit (CCU). These findings underscore the pre-existing cardiovascular risk burden faced by many patients with familial hypercholesterolemia. Encouragingly, none of the participants experienced new cardiovascular events during the one-year follow-up, including those with a history of MI, PCI, CABG, or PAD. While our study design precludes definitive conclusions about evolocumab's long-term impact on cardiovascular events, these initial observations are promising and warrant further investigation in larger trials. These observations align with findings from recent meta-analyses, such as the one by Ma *et al.* (2021), which demonstrated that PCSK9 inhibitors, compared to placebo, significantly reduce LDL-C levels and show promise for reducing Major Adverse Cardiac Events (MACE) including stroke and myocardial infarction.[24] Notably, their study found no significant difference in cardiovascular event prevention between PCSK9 inhibitors and ezetimibe, highlighting the potential advantages of Evolocumab for high-risk patients who may not respond adequately to other therapies.Furthermore, as highlighted by Berman and Blankstein (2019), PCSK9 inhibitors represent a significant recent advancement in dyslipidemia treatment.[25] Their review emphasizes the effectiveness of this drug class in lowering LDL-C and reducing cardiovascular events in high-risk patients – precisely the population we targeted in our study. This aligns with the growing recognition of the importance of risk assessment and targeted therapies, as emphasized by Karantas *et al.* (2021) in their review of updated dyslipidemia management guidelines.[26]

Our study adds to the growing evidence supporting evolocumab's effectiveness in managing dyslipidemia, particularly in high-risk patients with FH. The observed significant reduction in LDL-C aligns with findings from other PCSK9 inhibitor trials, such as the one by Blom *et al.* (2020) demonstrating similar reductions in HoFH patients using Alirocumab.14 This strengthens the case for evolocumab's ability to address the core challenge of elevated LDL-C in FH. Furthermore, our study complements the existing research on evolocumab's role in overcoming limitations of statin therapy. The BERSON trial design by Lorenzatti *et al.* (2018) targets patients with type 2 diabetes and dyslipidemia, reflecting a similar rationale for evolocumab in FH patients where statins may be insufficient.[27] However, it's important to acknowledge that our study did not differentiate between HeFH and HoFH subtypes, which might require tailored treatment approaches. Further investigation is warranted to explore this aspect. Also, while our analysis did not identify statistically significant associations between evolocumab efficacy and factors like prior cardiovascular history or baseline medications, the limited sample size necessitates further exploration in more comprehensive studies.

Systematic reviews like the one by AlHajri *et al.* (2017) analyzing data from multiple evolocumab trials offer a broader perspective on its effectiveness and highlight its potential for overcoming statin limitations.[28] Looking beyond LDL-C reduction, the review by Lazarte and Hegele (2020) emphasizes the multifaceted nature of dyslipidemia management, highlighting the importance of diet, lifestyle changes, and potentially targeting other lipids like triglycerides.[29] Evolocumab can be a valuable tool within a broader treatment plan, potentially alongside statins as the cornerstone therapy[30] or combined with ezetimibe for high-risk patients with uncontrolled LDL-C.[29] Future research can definitively assess how factors like prior cardiovascular history and baseline medications influence evolocumab's effectiveness in reducing cardiovascular risk. Additionally,

exploring the potential benefits of evolocumab in combination with other lipid-lowering strategies is warranted.
However, a key limitation lies in the relatively small sample size (50 participants). This limitation restricts the generalizability of our findings to the broader population with FH. Larger, multicenter trials with more diverse participants are necessary to confirm our observations with greater certainty and enhance the generalizability of the results. Future research could also explore the efficacy of evolocumab in different patient populations, such as those with other types of dyslipidemia or additional cardiovascular risk factors. Furthermore, investigating evolocumab's effectiveness in various treatment settings, including longer treatment durations or combination therapies with other lipid-lowering medications, would provide valuable information for optimizing patient care. By addressing these limitations and expanding the scope of future research, we can gain a more comprehensive understanding of evolocumab's role in managing dyslipidemia and reducing cardiovascular risk across a wider range of patients.
It is important to acknowledge the limitations of our study, particularly the relatively small sample size. Future research with larger and more diverse populations is needed to confirm our observations and enhance generalizability. Furthermore, investigating the impact of baseline lipid levels on treatment response and exploring evolocumab's efficacy in broader treatment settings are important areas for future exploration. Despite these limitations, our findings contribute valuable insights into evolocumab's potential for managing dyslipidemia and reducing cardiovascular risk in patients with familial hypercholesterolemia.

Conclusions

In conclusion, our study demonstrated that evolocumab treatment significantly improved lipid profiles in patients with familial hypercholesterolemia. Following one year of therapy, participants experienced a substantial reduction in LDL-C, with average levels approaching the recommended target range. Additionally, evolocumab treatment led to a decrease in triglycerides and a modest increase in HDL-C. These findings are consistent with prior research on evolocumab's efficacy in improving overall lipid profiles. Encouragingly, none of the participants with a history of prior cardiovascular events experienced new occurrences during the follow-up period, suggesting a potential association with reduced cardiovascular risk.

List of acronyms

LDL-C: low-density lipoprotein cholesterol.
HDL-C: high-density lipoprotein cholesterol.
FH: Familial hypercholesterolemia.
MI: Myocardial Infarction.
PCI: Percutaneous Coronary Intervention.
CABG: Coronary Artery Bypass Grafting.
PAD: Peripheral Artery Disease.
CCU: coronary care unit.
CVD: cardiovascular events.

Conflict of interest

The authors declare no potential conflict of interest, and all authors confirm accuracy.

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Ethics approval

The Ethics Committee of Baqiayatallah University of Medical Sciencesapproved this study (IR.BMSU.BAQ.REC.1402.052). The study is conformed with the Helsinki Declaration of 1964, as revised in 2013, concerning human and animal rights.

Informed consent

All patients participating in this study signed a written informed consent form for participating in this study.

Patient consent for publication

Written informed consent was obtained from a legally authorized representative(s) for anonymized patient information to be published in this article.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Corresponding Author

Ali Shamsedini, Atherosclerosis Research Center, Baqiayatallah University of Medical Sciences, Tehran, IR Iran.
ORICD ID: 0000-0002-0000-1236
E-mail: ali_shamsadini2000@yahoo.com

Maryam Moshkani Farahani
ORCID ID: 0000-0003-4902-273X
E-mail:Moshkani_farahani@yahoo.com

Alireza Nasiri
ORCID ID: 0000-0003-2608-3660
E-mail:alirezanasiri6592@yahoo.com
Mahdi Salari
ORCID ID: 0000-0001-8568-658X
E-mail:salaricardiologist@yahoo.com

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