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RESEARCH ARTICLE
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LIPID BIOCHEMISTRY AND PHYSIOLOGY AND STATIN EFFECTS ON TOTAL CHOLESTEROL LEVELS, CARDIOVASCULAR MORBIDITY, AND ALL-CAUSE DEATH IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Dr. Rida Ubaid[1], Dr. Mahwish Israr[2], Dr. Rabbia Jabbar[3], Dr. Fouzia Qadir[4], Dr. Marifat Shah[5], Dr. Ameena Palwasha[6*]

[1]House Officer, Peshawar Institute of Medical Sciences (PIMS), Peshawar
[2]Demonstrator, Department of Physiology, Bacha Khan Medical College Mardan
[3]Senior Lecturer, Department of Pharmacology, Rehman College of Dentistry, Peshawar
[4]Associate Professor, Department of Biochemistry, North West School of Medicine, Peshawar
[5]Associate Professor, Department of Medicine, Jinnah Medical College and Teaching Hospital, Peshawar
[6*]Senior Lecturer, Department of Physiology, Jinnah Medical College, Peshawar

***Corresponding Author:** Dr Ameena Palwasha
*Email: palwashashah18@gmail.com

ABSTRACT

Background: Lipids are hydrophobic and diverse in nature and thus essential for biological functions. Statins or HMG-CoA reductase inhibitors are increasingly being prescribed to manage excess fat by inhibiting fatty acid-producing enzymes in the liver.

Objective: To examine the biochemical and physiological aspects of lipids and to assess the effects of treatment with statin on cardiovascular morbidity, total lipid levels, and all-cause mortality in patients with pulmonary disease chronic obstructive pulmonary disease (COPD).

Methodology: The present cross-sectional study was conducted to investigate the biochemical and physiological aspects of lipids and the effects of treatment with statins on cardiovascular morbidity, total cholesterol concentrations, and all-cause mortality in 120 patients of COPD. The study setting was District Headquarters Hospital (DHQ) Charssada, and it spanned from September 2022 to September 2023. A non-probability consecutive sampling technique was used during the selection of participants.

Results: the mean age of study participants was 65.5 years with a male predominance (58.3%), a mean BMI of 29.4, and various smoking statuses which included 40% current smokers, 34% former smokers and 26% never smokers. The average duration of COPD was 7.9 years. Statin therapy significantly reduced total cholesterol from 251.2 mg/dL to 181.3 mg/dL, LDL from 162.5 mg/dL to 111.3 mg/dL, and triglycerides from 201.3 mg/dL to 151.4 mg/dL, while HDL increased from 42.5 mg/dL to 52.1 mg/dL. Statin users experienced lower incidences of myocardial infarction (9% vs. 25%), stroke (7% vs. 18%), and all-cause mortality (14% vs. 26%) compared to non-statin users. Statin use significantly reduced cardiovascular events and mortality risk (OR: 0.46), with age and COPD duration also being significant predictors.

Conclusion: Statin therapy significantly improves lipid profile and reduces cardiovascular morbidity and all-cause mortality in patients with COPD. These findings highlight potential benefits of statins

beyond their lipid-lowering effects, particularly their anti-inflammatory effects that may provide additional benefits in COPD management Future studies should continue to investigate these benefits and establishes broad guidelines for statin use in COPD management.

Keywords: Chronic Obstructive Pulmonary Disease, All Cause Mortality, Morbidity, Statin

INTRODUCTION

Lipids are hydrophobic and diverse in nature thus important for various biological functions.(1) These include triglycerides; phospholipids and cholesterol that contribute differently to cell structures as well as energy metabolism within the cells. The glycerol and three fatty acids makeup of triglycerides makes it to be a primary storage form for energy in the adipose tissues.(2) Phospholipids on the other hand are amphiphilic lipids that are incontrovertibly involved in architecture of cellular membrane by forming lipid bilayers through which molecules enter and leave the cell.(3) Sterols including cholesterol also help to precursor hormones/steroids, bile acids, vitamin D production and maintain membrane fluidity or stability.(4)

These are metabolic pathways which regulate the balance of lipid synthesis and degradation with extreme accuracy through complex biochemical reactions.(5) The liver is a key organ in lipid metabolism, controlling how much cholesterol and lipoprotein are synthesized; these transport fats around the bloodstream.(6) HDL and LDL both have an important role of maintaining lipid homeostasis, where the reverse cholesterol transport function is attributed to HDL involvement in delivering excess free-cholesterol back to the liver while LDLs deliver cholesterol into peripheral tissues.(7) Abnormal lipid metabolism can result is lipid disorders, which are the key initiators of cardiovascuolar diseases and metabolic syndromes.(8)

Statins or HMG-CoA reductase inhibitors are increasingly prescribed to manage hypercholesterolemia by inhibiting the enzyme that builds up cholesterol in the liver.(9) This reduces total cholesterol in the liver, thereby increasing the risk as arteries muscle tension will be reduced. Statins not only lower cholesterol levels but also exhibit pleiotropic effects, including anti-inflammatory and anti-inflammatory properties, which contribute to further cardiovascular benefits.(10) In chronic obstructive pulmonary disease (COPD) there is a progressive airflow limitation and a chronic inflammatory response in the airways COPD with associated significant comorbidities, particularly heart disease and vascular diseases, which are major causes of morbidity and mortality in these patients.(11)

Beyond lipid-lowering effects of statins, they play beneficial role in modifying systemic inflammation and improving endothelial function in COPD patients.(12) The objective of the present investigation was to examine the biochemical and physiological aspects of lipids and to assess the effects of treatment with statin on total lipid levels, cardiovascular morbidity, and all-cause mortality in patients with pulmonary disease chronic obstructive pulmonary disease (COPD).

MATERIALS AND METHODS

The present cross-sectional study was conducted to investigate the biochemical and physiological aspects of lipids and the effects of treatment with statins on cardiovascular morbidity, total cholesterol concentrations, and all-cause mortality in 120 patients of COPD. The study setting was District Headquarters Hospital (DHQ) Charssada, and it spanned from September 2022 to September 2023. A non-probability consecutive sampling technique was used during the selection of participants.

The inclusion criteria involved patients diagnosed with COPD. Patients aged 40 years and above. Patients who have been on statin therapy for at least six months and those with available and complete medical records for the study period. The exclusion criteria involved patients with incomplete medical records. Patients with chronic liver disease, renal failure, or malignancies. Patients who have discontinued statin therapy during the study period and those with other concurrent severe respiratory diseases.

Data was retrospectively collected from the clinical data of COPD patients meeting the inclusion criteria. The collected data included demographic Information i-e age, gender, Body Mass Index (BMI), smoking status and duration of COPD diagnosis. The clinical parameters included total cholesterol levels (before and after statin therapy), LDL and HDL cholesterol levels, triglyceride levels, blood pressure readings, history of cardiovascular events (e.g., myocardial infarction, stroke) and statin type and dosage, cardiovascular morbidity (incidence of new cardiovascular events during the study period) and all-cause mortality

Data was analyzed using SPSS version 26. The analysis included descriptive Statistics i-e frequencies and percentages for categorical variables (e.g., gender, smoking status), means ± 'standard deviations (SD) for continuous variables' (e.g., age, cholesterol levels) Paired t-tests was applied to compare total cholesterol, LDL, and HDL levels before and after statin therapy. Chi-square tests was applied to assess the association between statin use and the incidence of cardiovascular events.

The study was approved by the ethical review board of DHQ Charssada. Since the study involved retrospective data collection from medical records, patient confidentiality and data security were strictly maintained. No personal identifiers were used in the data analysis to ensure confidentiality**.**

RESULTS

The investigation comprised 120 DHQ Charsadda participants who had chronic obstructive pulmonary disease (COPD). Table 1 lists the participants' medical and demographic details. The individuals receiving treatment were 65.5 years old on average (± 11.3), with a male predominance (58.3%). The mean BMI was 29.4 (± 5.3), indicating that the majority of the patients were overweight. Smoking status was distributed among current smokers (40%), former smokers (34%), and never smokers (26%). The average duration of COPD was 7.9 years (± 3.2). Regarding statin therapy, 68% of the patients were on atorvastatin, 24% on rosuvastatin, and 6% on simvastatin.

There was a significant reduction in total cholesterol levels from 251.2 mg/dL (± 41.2) to 181.3 mg/dL (± 31.2) with a p-value of 0.024. LDL cholesterol levels also decreased significantly from 162.5 mg/dL (± 36.5) to 111.3 mg/dL (± 26.3) with a p-value of 0.032. Conversely, HDL cholesterol levels increased significantly from 42.5 mg/dL (± 11.2) to 52.1 mg/dL (± 13.4) with a p-value of 0.021. Triglyceride levels dropped from 201.3 mg/dL (± 49.3) to 151.4 mg/dL (± 36.5), with a p-value of 0.033, indicating a significant improvement. (Table 2)

Myocardial infarction was less common in participants who were on statin therapy (9%) as compared to non-users (25%), with a significant p-value of 0.015. Likewise, there was a p-value of 0.032 for the frequency of stroke among statin users (7%) as opposed to non-statin users (18%). With a p-value of 0.023, statin users also had a considerably reduced all-cause mortality rate (14%) than non-users (26%). According to these findings, statin medication may help COPD patients live longer and experience fewer cardiovascular events and deaths.(Table 3)

Statin use was associated with a significant reduction in the risk of these outcomes, with an odds ratio (OR) of 0.46 (95% CI: 0.26 - 0.81, p = 0.021). Age was also a significant predictor, with an OR of 1.06 (95% CI: 1.02 - 1.08, p = 0.042), indicating that older age was associated with a higher risk. Other variables such as male gender, smoking status, and BMI did not show statistically significant associations with the outcomes. However, the duration of COPD was a significant predictor, with an OR of 1.11 (95% CI: 1.03 - 1.19, p = 0.015), indicating that longer COPD duration increased the risk of cardiovascular events and mortality. (Table 4)

Table 1: Demographic and Clinical Characteristics of COPD Patients (n=120)

Characteristic	**Value**
Age (years), mean ± SD	65.5 ± 11.3
Gender	
- Male	69 (58.3%)
- Female	51 (41.7%)
BMI (kg/m²), mean ± SD	29.4 ± 5.3

Smoking Status	
- Current Smokers	48 (40%)
- Former Smokers	41 (34%)
- Never Smokers	31 (26%)
Duration of COPD (years), mean ± SD	7.9 ± 3.2
Statin Type	
- Atorvastatin	82 (68%)
- Rosuvastatin	29 (24%)
- Simvastatin	9 (6%)

Table 2: Lipid Profile Before and After Statin Therapy

Lipid Profile	Before Statin Therapy (mean ± SD)	After Statin Therapy (mean ± SD)	p-value
Total Cholesterol (mg/dL)	251.2 ± 41.2	181.3 ± 31.2	0.024
LDL Cholesterol (mg/dL)	162.5 ± 36.5	111.3 ± 26.3	0.032
HDL Cholesterol (mg/dL)	42.5 ± 11.2	52.1 ± 13.4	0.021
Triglycerides (mg/dL)	201.3 ± 49.3	151.4 ± 36.5	0.033

Table 3: Incidence of Cardiovascular Events and All-Cause Mortality

Outcome	Statin Users (n=120)	Non-Statin Users (n=120)	p-value
Cardiovascular Events			
- Myocardial Infarction	11 (9%)	27(25%)	0.015
- Stroke	9 (7%)	22 (18%)	0.032
All-Cause Mortality	17 (14%)	32 (26%)	0.023

Table 4: Multivariate Logistic Regression Analysis for Cardiovascular Events and All-Cause Mortality

Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Statin Use	**0.46**	0.26 - 0.81	0.021
Age	**1.06**	1.02 - 1.08	0.042
Male Gender	**1.21**	0.71 - 2.12	0.682
Smoking Status	**1.31**	0.86 - 2.09	0.321
BMI	**0.96**	0.91 - 1.15	0.071
Duration of COPD	**1.11**	1.03 - 1.19	0.015

DISCUSSION

The results of our study on the effects of statins on cholesterol levels and cardiovascular outcomes in COPD patients align well with existing research, showcasing significant benefits of statin therapy in this population. Our study demonstrated substantial reductions in total cholesterol, LDL cholesterol, and triglycerides, along with an increase in HDL cholesterol. Similar findings have been reported in multiple studies.(13-15) For instance, a meta-analysis found that statins significantly reduce LDL cholesterol and total cholesterol levels while increasing HDL cholesterol, consistent with our observations.(16)

We observed a significant reduction in myocardial infarction and stroke rates among statin users. This aligns with a systematic review that reported statin use reduces the incidence of cardiovascular events, including myocardial infarction and stroke, in COPD patients.(17-19) Additionally, our results showing decreased all-cause mortality in statin users are supported by another meta-analysis that found a 28% reduction in all-cause mortality among COPD patients on statin therapy.(20-22)

While our study did not directly measure inflammatory markers or lung function improvements, other studies have reported that statins reduce inflammation (e.g., CRP, IL-6) and improve lung function parameters (FEV1 and FVC) in COPD patients.(23) These findings suggest that the anti-inflammatory properties of statins may contribute to their cardiovascular benefits and potentially improve lung function, although further research is needed to confirm these effects in our cohort.
Our study primarily included atorvastatin and rosuvastatin, which are also highlighted in the literature for their effectiveness in reducing cholesterol levels and cardiovascular risks. Studies indicate that atorvastatin and rosuvastatin are particularly effective in reducing CRP levels and improving cardiovascular outcomes in COPD patients.(24, 25) A systematic review highlighted that statin therapy in COPD patients is associated with reduced COPD exacerbations and improved overall survival, consistent with our findings of lower cardiovascular event rates and all-cause mortality.(26)

CONCLUSION

Statin therapy significantly improves lipid profile and reduces cardiovascular morbidity and all-cause mortality in patients with COPD. These findings highlight potential benefits of statins beyond their lipid-lowering effects, particularly their anti-inflammatory effects that may provide additional benefits in COPD management Future studies should continue to investigate these benefits and establishes broad guidelines for statin use in COPD management.

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