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INVESTIGATIONS OF LIPID PROFILE LEVELS IN PATIENTS TAKING ANTIHYPERTENSIVE MEDICATION: A PROSPECTIVE COMPARATIVE STUDY

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ABSTRACT: Background: Hypertension commonly coexists with dyslipidemia, thereby increasing cardiovascular risk. Antihypertensive agents such as angiotensin-converting enzyme inhibitors and angiotensin receptor blockers may differ in their effects on lipid metabolism. This study aimed to compare the effects of ramipril and telmisartan on serum lipid profile in patients with newly diagnosed essential hypertension. **Materials and Methods:** This was a prospective, randomized, comparative study conducted over 24 weeks in the Department of Pharmacology in collaboration with the Department of Cardiology. Patients aged 30–60 years with newly diagnosed grade 1 hypertension were enrolled. A total of 120 patients completed the study and were randomized to receive either ramipril 2.5 mg once daily (Group 1) or telmisartan 40 mg once daily (Group 2). Serum total cholesterol (TC), triglycerides (TG), low-density lipoprotein (LDL), and high-density lipoprotein (HDL) were assessed at baseline and during follow-up. Data were analyzed using Student's t-test. **Results:** Both treatment groups demonstrated improvement in lipid parameters over the study period. Telmisartan showed a significant reduction in TC, TG, and LDL levels, whereas ramipril produced significant reductions in TC and LDL. Changes in HDL levels were modest in both groups. Although telmisartan demonstrated a greater percentage improvement in lipid parameters, intergroup comparison at the end of 24 weeks showed no statistically significant difference. **Conclusion:** Ramipril and telmisartan exhibited favorable or neutral effects on serum lipid profile in patients with newly diagnosed hypertension. Telmisartan showed a trend toward better lipid modulation, suggesting it may be a preferred option in hypertensive patients with associated dyslipidemia.

INTRODUCTION: Hypertension and dyslipidemia frequently coexist and together substantially increase the risk of cardiovascular morbidity and mortality.

Compared with normotensive individuals, patients with hypertension commonly exhibit elevated total cholesterol (TC), triglycerides (TG), and low-density lipoprotein cholesterol (LDL-C), along with reduced high-density lipoprotein cholesterol (HDL-C), thereby accelerating the development of atherosclerotic cardiovascular disease ¹. When lifestyle modifications fail to achieve adequate blood pressure control, pharmacological therapy becomes necessary ². Among antihypertensive agents, angiotensin-converting enzyme (ACE) inhibitors and angiotensin II type-1 receptor

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blockers (ARBs) are widely prescribed because of their proven efficacy and favorable tolerability profiles. Ramipril, an ACE inhibitor, and telmisartan, an ARB, are commonly used in the management of essential hypertension. Beyond blood pressure reduction, antihypertensive drugs may influence metabolic parameters, including lipid metabolism, which is clinically relevant in patients with coexisting dyslipidemia³.

Certain antihypertensive drug classes, such as conventional β -blockers and thiazide diuretics, have been associated with adverse effects on lipid and glucose metabolism. In contrast, ACE inhibitors have been shown to exert neutral or modestly beneficial effects on lipid profile and insulin sensitivity⁴⁻⁶. Additionally, ACE inhibitors may provide protective effects against vascular and renal damage associated with metabolic disorders⁷.

ARBs have also demonstrated favorable metabolic effects, and experimental as well as clinical studies suggest that telmisartan may reduce triglyceride accumulation through mechanisms partly independent of its antihypertensive action⁸.

However, comparative data evaluating the effects of ramipril and telmisartan on lipid profile, particularly in the Indian population, remain limited. Therefore, the present study was undertaken to evaluate and compare the effects of ramipril and telmisartan on serum TC, TG, LDL-C, and HDL-C levels in patients with newly diagnosed essential hypertension.

MATERIALS AND METHODS:

Study Design and Ethical Approval: This prospective, randomized, open-label, comparative study was conducted at Shri Ram MurtiSmarak Institute of Medical Sciences (SRMSIMS), Bareilly, Uttar Pradesh, in the Department of Pharmacology in collaboration with the Department of Cardiology. Ethical approval was obtained from the Institutional Ethics Committee (Ref. No. SRMSIMS/2016-17/67-E). Written informed consent was obtained from all participants prior to enrollment.

Study Population: Patients of either gender aged 30–60 years with newly diagnosed grade-1 essential hypertension (systolic blood pressure 140–159 mmHg and/or diastolic blood pressure

90–99 mmHg) were included in the study. Patients were excluded if they were younger than 30 years or older than 60 years; had uncontrolled or malignant hypertension, secondary hypertension, congestive heart failure, unstable angina, recent myocardial infarction, hepatic or renal dysfunction; were pregnant or lactating; or were receiving two or more antihypertensive drugs.

Sample Size and Randomization: A total of 120 patients were enrolled based on feasibility and outpatient attendance during the study period. Participants were randomized into two treatment groups using a computer-generated random number table. Allocation concealment was ensured using sequentially numbered, sealed opaque envelopes, which were opened at the time of enrollment.

Study Groups and Drug Administration:

Group 1 (n = 58): Ramipril was initiated at 2.5 mg once daily in the morning and titrated to 5 mg if blood pressure control was inadequate.

Group 2 (n = 62): Telmisartan was initiated at 40 mg once daily in the morning and titrated to 80 mg when required.

Dose selection was based on standard recommended starting and maintenance doses for essential hypertension as per current clinical guidelines. Dose titration was performed if systolic blood pressure exceeded 160 mmHg or diastolic blood pressure exceeded 100 mmHg during follow-up.

Study Conduct and Follow-up: Patients were followed for 24 weeks, with visits every six weeks for blood pressure assessment. Serum lipid profile TC, TG, LDL-C, and HDL-C was measured at baseline, 12 weeks, and 24 weeks after overnight fasting. All patients received standardized lifestyle modification counseling. Atorvastatin therapy was prescribed in both groups as per the American College of Cardiology/American Heart Association (ACC/AHA) 2013 guidelines⁹; its potential confounding effect on lipid outcomes was considered a study limitation.

Statistical Analysis: Data were analyzed using SPSS version 25.0. Continuous variables were expressed as mean \pm standard deviation (SD), and

categorical variables as percentages. Data normality was assessed using the Shapiro–Wilk test. Within-group comparisons were performed using the paired Student’s t-test, and intergroup comparisons using the unpaired Student’s t-test. A two-tailed p value < 0.05 was considered statistically significant. Only patients who completed the study were included in the final analysis.

RESULTS:

Baseline Characteristics: All 120 patients completed the study: Group 1 (ramipril, n = 58) and Group 2 (telmisartan, n = 62). Baseline demographics, body mass index (BMI), smoking status, systolic blood pressure (SBP), diastolic blood pressure (DBP), and lipid parameters (TC, TG, LDL-C, HDL-C) were comparable (p > 0.05)

Table 1.

TABLE 1: BASELINE DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

| Parameter | Ramipril (n=58) Group 1 | Telmisartan (n=62) Group 2 | p value |
|--------------------------|-------------------------|----------------------------|---------|
| Age (years) | 53.67 ± 5.35 | 53.95 ± 4.67 | 0.50 |
| Gender (M/F) | 38/20 | 37/25 | 0.637 |
| BMI (kg/m ²) | 23.69 ± 3.86 | 23.72 ± 3.18 | 0.96 |
| Smoking (Yes/No) | 10/48 | 12/50 | 0.948 |
| SBP (mmHg) | 154.18 ± 4.58 | 153.32 ± 4.55 | 0.30 |
| DBP (mmHg) | 93.18 ± 3.12 | 93.56 ± 3.78 | 0.32 |
| TC (mg/dl) | 194.12 ± 18.59 | 192.64 ± 15.47 | 0.63 |
| TG (mg/dl) | 141.24 ± 11.60 | 138.80 ± 9.64 | 0.21 |
| LDL (mg/dl) | 120.08 ± 22.74 | 124.93 ± 21.00 | 0.22 |
| HDL (mg/dl) | 47.77 ± 4.25 | 47.66 ± 4.23 | 0.88 |

Values expressed as mean ± SD. p > 0.05 indicates no statistically significant difference between groups.

Comparison of Lipid Profile Between Groups:

At baseline, second follow-up (12 weeks), and fourth follow-up (24 weeks), intergroup comparison of serum TC, TG, LDL, and HDL

levels showed no statistically significant difference between the ramipril and telmisartan groups (p > 0.05 for all comparisons) **Table 2.**

TABLE 2: COMPARISON OF SERUM LIPID PROFILE BETWEEN GROUPS AT BASELINE AND FOLLOW-UP VISITS

| Visit | Parameter | Ramipril (n = 58) | Telmisartan (n = 62) | P-value |
|----------|-------------------|-------------------|----------------------|---------|
| Baseline | Serum TC (mg/dL) | 194.12 ± 18.59 | 192.64 ± 15.47 | 0.63 |
| | Serum TG (mg/dL) | 141.24 ± 11.60 | 138.80 ± 9.64 | 0.21 |
| | Serum LDL (mg/dL) | 120.08 ± 22.74 | 124.93 ± 21.00 | 0.22 |
| | Serum HDL (mg/dL) | 47.77 ± 4.25 | 47.66 ± 4.23 | 0.88 |
| 12 weeks | Serum TC (mg/dL) | 191.98 ± 16.91 | 190.91 ± 14.13 | 0.71 |
| | Serum TG (mg/dL) | 140.89 ± 12.24 | 137.90 ± 9.15 | 0.13 |
| | Serum LDL (mg/dL) | 112.84 ± 18.96 | 116.64 ± 16.79 | 0.24 |
| | Serum HDL (mg/dL) | 48.74 ± 4.31 | 47.90 ± 4.03 | 0.27 |
| 24 weeks | Serum TC (mg/dL) | 191.00 ± 15.95 | 189.66 ± 14.47 | 0.63 |
| | Serum TG (mg/dL) | 139.98 ± 12.61 | 137.06 ± 9.52 | 0.15 |
| | Serum LDL (mg/dL) | 113.05 ± 17.60 | 113.35 ± 13.15 | 0.95 |
| | Serum HDL (mg/dL) | 48.65 ± 4.20 | 48.75 ± 3.70 | 0.88 |

Values expressed as mean ± SD (mg/dl). Intergroup comparison using unpaired Student’s t-test. p > 0.05 for all parameters.

Within-Group Changes in Lipid Parameters:

Within-group analysis demonstrated that in Group 1 (ramipril), a statistically significant reduction was observed in TC and LDL levels from baseline to the fourth follow-up visit (p ≤ 0.05). Changes in TG and HDL levels in this group were not statistically significant (p > 0.05) **Table 3.** In

Group 2 (telmisartan), significant reductions were observed in TC, TG, and LDL levels from baseline to the fourth follow-up visit (p < 0.05). Although HDL levels increased during follow-up, this change did not reach statistical significance (p > 0.05)

Table 3.

TABLE 3: WITHIN-GROUP COMPARISON OF LIPID PARAMETERS BETWEEN BASELINE AND 24 WEEKS

| Parameter | Baseline (mean ± SD) | 24 Week s(mean ± SD) | P-value |
|------------------------|----------------------|----------------------|---------|
| Ramipril (n=58) | | | |
| Serum TC (mg/dL) | 194.12 ± 18.59 | 191.00 ± 15.95 | 0.04* |

| | | | |
|---------------------------|----------------|----------------|-------|
| Serum TG (mg/dL) | 141.24 ± 11.60 | 139.98 ± 12.61 | 0.22 |
| Serum LDL (mg/dL) | 120.08 ± 22.74 | 113.05 ± 17.60 | 0.05* |
| Serum HDL (mg/dL) | 47.77 ± 4.25 | 48.65 ± 4.20 | 0.16 |
| Telmisartan (n=62) | | | |
| Serum TC (mg/dL) | 192.64 ± 15.47 | 189.66 ± 14.47 | 0.02* |
| Serum TG (mg/dL) | 138.80 ± 9.64 | 137.06 ± 9.52 | 0.04* |
| Serum LDL (mg/dL) | 124.93 ± 21.00 | 113.35 ± 13.15 | 0.01* |
| Serum HDL (mg/dL) | 47.66 ± 4.23 | 48.75 ± 3.70 | 0.08 |

Values expressed as mean ± SD (mg/dL). Within-group comparison using paired Student's t-test. *Statistically significant ($p < 0.05$).

Percentage Change in Lipid Parameters:

Percentage change analysis showed that from baseline to the fourth follow-up visit, Group 2 demonstrated a greater percentage reduction in TC,

TG, and LDL levels and a higher percentage increase in HDL levels compared to Group 1. However, these differences between groups were not statistically significant ($p > 0.05$) **Table 4**.

TABLE 4: PERCENTAGE CHANGE IN SERUM LIPID PARAMETERS FROM BASELINE TO 24 WEEKS

| Parameter | Ramipril (n=58) | Telmisartan (n=62) |
|-----------------|-----------------|--------------------|
| % Change in TC | -1.61% | -1.52% |
| % Change in TG | -0.90% | -1.27% |
| % Change in LDL | -5.76% | -9.28% |
| % Change in HDL | +1.81% | +2.29% |

Percentage change calculated as [(24 weeks – baseline)/baseline × 100]. Intergroup comparisons not statistically significant ($p > 0.05$).

DISCUSSION: The present study evaluated the effects of ramipril and telmisartan on serum lipid parameters in patients with grade-1 hypertension over a six-month treatment period. Baseline demographic characteristics, smoking status, body mass index, blood pressure, and lipid profiles were comparable between the two treatment groups, ensuring appropriate group comparability and minimizing baseline confounding.

Both ramipril and telmisartan were associated with modest improvements in TC and LDL-C levels after six months of therapy, while no significant changes were observed at the interim follow-up. These findings are consistent with earlier reports suggesting that ACE inhibitors exert neutral to mildly favorable effects on lipid metabolism, possibly through reduction of oxidative stress and improvement in endothelial function¹⁰⁻¹². Previous studies have also documented reductions in TC and LDL-C with ramipril, supporting its metabolic neutrality in hypertensive patients¹³.

Telmisartan demonstrated a trend toward greater improvement in TG and HDL-C levels, although these differences were not statistically significant when compared between groups. This observation is biologically plausible, as telmisartan possesses partial peroxisome proliferator-activated receptor

(PPAR)-modulating activity, which may enhance fatty acid oxidation and influence lipid homeostasis¹⁴⁻¹⁶. Prior clinical studies, including the Saga Telmisartan Aggressive Research (STAR) trial, have reported comparable metabolic effects with telmisartan, lending support to the trends observed in the present study¹⁷.

Nevertheless, interpretation of these findings warrants caution. Concomitant statin therapy administered to a subset of patients in both groups represents an important confounding factor and limits attribution of lipid changes solely to the antihypertensive agents. Overall, while telmisartan demonstrated favorable metabolic trends, both drugs exhibited largely comparable effects on lipid parameters.

Limitations: Several limitations of this study should be acknowledged. First, although the follow-up duration was six months, a longer observation period may be required to fully elucidate long-term metabolic effects and cardiovascular risk modification. Second, the use of concomitant statin therapy in a subset of participants constitutes a major confounding factor in evaluating lipid outcomes. Third, the relatively modest sample size and inclusion of only two antihypertensive agents limit the generalizability of

the findings. Future studies with larger populations, longer follow-up, and statin-free or stratified study designs are required to confirm these observations.

CONCLUSION: In this prospective study, both ramipril and telmisartan demonstrated neutral to modestly favorable effects on serum lipid parameters in patients with grade 1 hypertension over a six-month treatment period. Telmisartan showed trends toward greater improvement in total cholesterol, triglycerides, and LDL cholesterol, along with a mild increase in HDL cholesterol; however, no statistically significant differences were observed between the two treatment groups. Ramipril exhibited a largely neutral lipid profile with modest improvement in selected parameters. Given the influence of concomitant statin therapy and the absence of significant intergroup differences, the results should be interpreted cautiously.

While telmisartan may offer potential metabolic advantages, definitive conclusions regarding its superiority over ramipril cannot be drawn. Further large-scale, long-term, and adequately controlled studies are needed to clarify the comparative metabolic effects of antihypertensive agents.

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