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Research Article

EFFICACY AND SAFETY OF ANGIOTENSIN RECEPTOR BLOCKERS IN STAGE 1 HYPERTENSION: A HOSPITAL-BASED OBSERVATIONAL STUDY

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ABSTRACT

Objectives: This study aimed to evaluate the efficacy, safety, and tolerability of three commonly used angiotensin receptor blockers (ARBs)-losartan, telmisartan, and olmesartan-in managing stage 1 hypertension among patients aged 40–60 years.

Methods: A prospective observational study was conducted at a tertiary care hospital from March 2023 to March 2024. A total of 100 patients with stage 1 hypertension, as per joint national committee 8 criteria, were enrolled. Patients were randomly assigned to receive losartan (50–100 mg), telmisartan (40–80 mg), or olmesartan (20–40 mg) as monotherapy. Blood pressure, biochemical parameters, and adverse effects were monitored at baseline and at 15-day intervals for 3 months. Patients with secondary hypertension or compelling indications for other antihypertensive classes were excluded from the study.

Results: All three ARBs effectively reduced systolic and diastolic blood pressure (DBP). At 3 months, Olmesartan showed the highest mean reduction (systolic blood pressure: 30 mmHg, diastolic blood pressure: 16 mmHg), followed by telmisartan (26/12 mmHg) and losartan (20/12 mmHg). There were no significant changes in lipid profiles, renal function, or serum electrolytes. Only one patient experienced a mild headache with olmesartan. No serious adverse events occurred, and compliance was 100% throughout the study period.

Conclusion: ARBs are effective and well-tolerated in the treatment of stage 1 hypertension. Olmesartan demonstrated superior blood pressure control compared to losartan and telmisartan, without significant impact on biochemical parameters, highlighting its potential as a preferred monotherapy option.

Keywords: Angiotensin receptor blockers, Hypertension, Losartan, Telmisartan, Olmesartan, Blood pressure, Joint National Committee 8, Efficacy, Safety, Stage 1 hypertension.

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INTRODUCTION

Hypertension, commonly known as high blood pressure, remains a leading global public health concern and a primary contributor to cardiovascular, cerebrovascular, and renal morbidity and mortality. Often dubbed the "silent killer" due to its asymptomatic progression, hypertension is clinically defined by a persistent elevation in systolic blood pressure (SBP) (≥140 mmHg) and/or diastolic blood pressure (DBP) (≥90 mmHg), according to the guidelines set forth by the eighth joint national committee (JNC 8) [1]. Of particular concern is Stage 1 hypertension, characterized by a systolic range of 140–159 mmHg or a diastolic range of 90–99 mmHg [1]. Timely detection and therapeutic intervention at this stage are crucial, as they offer the opportunity to prevent target organ damage and significantly reduce the long-term burden of associated complications [2,3].

Despite the availability of effective antihypertensive medications, global data indicate suboptimal blood pressure control, particularly in developing countries, where awareness, treatment, and adherence remain major challenges [2]. Lifestyle modifications such as dietary regulation, weight management, regular physical activity, and avoidance of alcohol and tobacco are universally recommended by hypertension guidelines; however, patient compliance with these measures is frequently poor [4]. Angiotensin receptor blockers (ARBs) have emerged as a cornerstone in the pharmacologic management of hypertension. Endorsed by the JNC 8 for use in patients with contraindications to angiotensin-converting enzyme (ACE) inhibitors or thiazide diuretics, ARBs are associated with high tolerability, a low incidence of side effects, and favorable metabolic profiles [5]. Among the commonly prescribed ARBs, losartan, telmisartan, and olmesartan stand out due to their proven efficacy, wide availability, and cost-effectiveness in both primary care and tertiary settings [6]. This study was undertaken to evaluate the comparative effectiveness, safety, and tolerability of these three ARBs in patients aged 40–60 years with stage 1 hypertension. By assessing blood pressure control, biochemical profiles, adverse effects, and patient compliance over a 3-month treatment period, this study aims to provide real-world evidence on the utility of ARBs as monotherapy in early-stage hypertension management.

METHODS

This prospective observational study was conducted at a tertiary care hospital, at the Department of General Medicine, Dr. N.D. Desai Faculty of Medical Science and Research, Dharmsinh Desai University, Gujarat, over a 1-year period, from March 2023 to March 2024. The study enrolled 100 patients aged between 40 and 60 years who were diagnosed with stage 1 hypertension, as defined by the JNC 8 guidelines (SBP 140–159 mmHg and/or diastolic pressure 90–99 mmHg).

Inclusion criteria

1. Adults aged 40–60 years
2. Diagnosed with Stage 1 hypertension as per JNC 8 guidelines (Systolic blood pressure (BP): 140–159 mmHg and/or DBP: 90–99 mmHg)

3. Not currently on antihypertensive therapy or have completed an appropriate washout period
4. Willing and able to provide written informed consent and comply with the study protocol
5. Physically and mentally fit to take oral medications and attend regular follow-up visits.

Exclusion criteria

1. Patients with secondary hypertension or hypertensive crises/ emergencies.
2. Presence of compelling indications for non-ARB antihypertensive therapy (e.g., diabetes mellitus, chronic kidney disease, and heart failure).
3. Known allergy or hypersensitivity to any of the study drugs (Losartan, Telmisartan, or Olmesartan).
4. Pregnant or breastfeeding women.
5. Evidence of significant renal or hepatic dysfunction on baseline biochemical evaluation.

The sample size was determined based on the expected mean reduction in SBP among the three ARB groups, considering previous literature and clinically significant differences. Assuming an effect size of 0.35 (moderate), power of 80% (1−β=0.80), and α=0.05, a minimum of 27 subjects per group was required to detect a significant difference using one-way analysis of variance (ANOVA). To account for potential dropouts and to strengthen statistical power, the sample size was rounded up to 100 participants, with approximately 33 subjects per group (losartan, telmisartan, and olmesartan). The final sample size of 100 ensured adequate power to evaluate efficacy, safety, and tolerability differences between the ARBs over the 3-month follow-up period. Patients were randomly assigned to receive one of three ARBs: Losartan (50–100 mg/day), Telmisartan (40–80 mg/day), or Olmesartan (20–40 mg/day) as monotherapy. Randomization was done using a simple rotating allocation method to avoid selection bias. Patients were followed up at 15-day intervals for a total duration of 3 months.

At each follow-up, seated BP was recorded using a standard mercury sphygmomanometer with appropriate cuff size. Baseline and follow-up investigations included serum electrolytes, renal function tests, random blood sugar (RBS), lipid profile, and liver enzymes. Patients were also monitored for side effects and compliance at every visit. Adverse effects were recorded, and patients were instructed to report any symptoms between visits. The primary endpoint was defined as achieving a target BP<140/90 mmHg at 3 months. Secondary endpoints included assessment of biochemical parameters, adverse drug reactions, and overall compliance with therapy. Ethical approval was obtained from the institutional ethics committee, and informed consent was taken from all participants before enrolment.

Statistical analysis

All collected data were entered into Microsoft Excel and analyzed using the IBM statistical package for the social sciences Statistics Version 25.0. Continuous variables, such as systolic and DBP and biochemical parameters, were expressed as mean±standard deviation. Categorical variables, such as adverse events and gender distribution, were presented as frequencies and percentages. Intragroup comparisons (baseline vs. follow-up at 15-day intervals) were assessed using repeated measures ANOVA or paired t-test, depending on the data distribution. Intergroup comparisons (between Losartan, Telmisartan, and Olmesartan groups) for BP reduction and biochemical parameters were analyzed using one-way ANOVA, followed by *post hoc* Tukey's test if significance was found. The level of statistical significance was set at $p<0.05$. All analyses were two-tailed, and confidence intervals (95% CI) were calculated where appropriate to estimate the precision of the observed effects.

RESULTS

Table 1 illustrates the distribution of SBP values at multiple time points-15 days, 1 month, 2 months, and 3 months-following initiation of ARB monotherapy. A consistent downward trend in systolic BP was observed over the treatment period. At baseline (15 days), a majority of patients had SBP in the range of 150–159 mmHg (43%), which steadily reduced to only 6% by 3 months. Conversely, patients with SBP in the optimal range of 120–129 mmHg increased from 5% to 38% by the end of the study. This demonstrates the time-dependent efficacy of ARBs in lowering SBP in stage 1 hypertensive patients (Fig. 1).

Table 2 presents the changes in DBP across the same 4 time points. Initially, 58% of patients had DBP between 90 and 100 mmHg, which decreased to 33% at 3 months. Meanwhile, those achieving target DBP in the 80–89 mmHg range increased from 42% to 67%. These findings reinforce the gradual and sustained reduction in DBP following ARB therapy, reflecting their effectiveness in achieving JNC 8 BP goals.

Table 3 summarizes the adverse drug reactions reported with each ARB agent. Notably, only one case of mild headache was reported in a patient on olmesartan. No significant side effects such as hypotension, cough, angioedema, or electrolyte imbalance were observed in any group. This confirms the excellent tolerability and safety profile of ARBs, making them suitable for long-term monotherapy in stage 1 hypertension.

The effect of ARBs on heart rate was minimal. The mean pulse rate increased marginally from 78.5 to 79.7 beats/min over the study period, indicating that ARBs do not significantly influence sympathetic tone or heart rate. This is consistent with their pharmacological profile and supports their safety in patients with borderline cardiac function (Table 4).

No significant changes were observed in lipid parameters during ARB therapy. Minimal reductions in total cholesterol (0.7 mg/dL),

Table 1: SBP reduction after ARBs treatment

SBP	After 15 days	After 1 month	After 2 months	After 3 months
150–159	43	25	8	6
140–149	34	28	38	42
130–139	18	34	42	14
120–129	5	13	12	38

Mean SBP (mmHg)-15 days: 148.2±5.6, 1 month: 139.4±6.1, 2 months: 132.8±5.9, 3 months: 128.4±5.2. SBP: Systolic blood pressure, ARBs: Angiotensin receptor blockers

Table 2: DBP reduction after ARBs treatment

DBP	After 15 days	After 1 month	After 2 months	After 3 months
90–100	58	40	43	33
80–89	42	60	57	67

Mean DBP (mmHg)-15 days: 94.7±4.2, 1 month: 89.3±4.8, 2 months: 86.2±4.5, 3 months: 83.6±4.3. ARBs: Angiotensin receptor blockers, BP: Blood pressure, DBP: Diastolic blood pressure

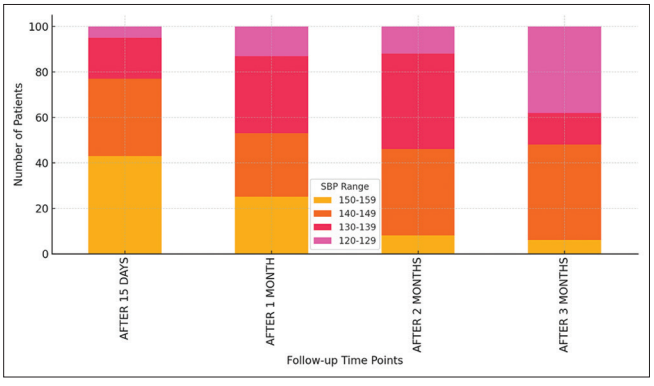

Fig. 1: Systolic blood pressure distribution over time

Table 3: Adverse effects observed during follow-up

Adverse effects	Losartan	Telmisartan	Olmesartan
Headache	0	0	1
Nausea/vomiting	0	0	0
Giddiness/dizziness	0	0	0
Cough	0	0	0
Fatigue	0	0	0
Diarrhea	0	0	0
Hypotension	0	0	0
Pruritus	0	0	0
Angioneurotic enema	0	0	0
Rash	0	0	0
Oliguria	0	0	0
Syncope	0	0	0

Only one mild headache was reported in the Olmesartan group; no other adverse effects observed

Table 4: Effect on pulse rate

Pre-treatment mean pulse rate (per minute)	Post-treatment mean pulse rate (per minute)	Difference
78.5	79.7	1.2

Mean pulse rate-pre-treatment: 78.5±4.0, Post-treatment: 79.7±4.3

low-density lipoprotein (0.6 mg/dL), and triglycerides (0.4 mg/dL) were noted. High-density lipoprotein showed a marginal decrease. However, since many patients were on concurrent atorvastatin therapy for cerebrovascular protection, the independent effect of ARBs on lipid metabolism could not be conclusively assessed in this study (Table 5 and Fig. 2).

ARBs had no clinically significant impact on renal function (blood urea, serum creatinine), liver enzymes serum glutamic pyruvic transaminase, electrolytes (sodium, potassium), or blood glucose RBS. These parameters remained stable throughout the study duration, indicating the metabolic neutrality and organ safety of ARBs. This further supports their use as first-line antihypertensive agents, especially in patients without comorbid conditions (Table 6).

DISCUSSION

Hypertension, often referred to as the "silent killer," is a major public health concern globally and in India [2]. Stage 1 hypertension, as defined by the JNC 8 guidelines, necessitates early and effective intervention to prevent target organ damage and reduce long-term cardiovascular morbidity and mortality. This study assessed the efficacy and safety of ARBs-specifically losartan, telmisartan, and olmesartan-in a cohort of 100 patients aged 40–60 years with newly diagnosed stage 1 hypertension [5]. The primary goal of antihypertensive therapy is effective BP control without compromising patient safety or tolerability. Our results demonstrate that ARBs significantly reduced both systolic and DBPs over a 3-month period. Notably, olmesartan showed the highest reduction in systolic (30 mmHg) and diastolic (16 mmHg) BP, followed by telmisartan (26/12 mmHg) and losartan (20/12 mmHg). These findings are consistent with previous studies, where olmesartan demonstrated superior BP-lowering efficacy compared to other ARBs [7], telmisartan provided sustained 24-h control [8], and losartan proved effective, particularly in mild-to-moderate hypertension [9].

Fasce and Wageman [10] and Cheung and Cheung [11] documented a systolic BP reduction of 28 mmHg and 14 mmHg, respectively, with losartan. Our findings of a 20 mmHg reduction align well within this range. Telmisartan's effects corroborated the outcomes in studies by White *et al.* [12] and Nishimura *et al.* [13], which reported reductions between 17 and 28 mmHg for systolic BP. Olmesartan produced greater reductions, which are consistent with the findings of Ram [14] and Cheung and Cheung [11], suggesting a potentially superior efficacy

Table 5: Effect on plasma lipid profile

Lipid profile	Mean pre-treatment reading (mg/dL)	Mean post-treatment reading (mg/dL)	Mean reduction (mg/dL)
HDL	41.13	40.43	0.7
LDL	131.18	130.5	0.6
Triglyceride	170.38	169.9	0.4
Cholesterol	210.88	210.12	0.7

Cholesterol-210.88±13.9→210.12±14.1, LDL-131.18±12.2→130.5±12.0, HDL-41.13±3.4→40.43±3.3, Triglycerides-170.38±17.5→169.9±18.2.
HDL: High-density lipoprotein, LDL: Low-density lipoprotein

Table 6: Effect on other biochemical parameters

Parameter	Mean pre-treatment reading	Mean post-treatment reading	Mean reduction
Blood urea (mg %)	31.0	30.6	0.4
S. creatinine (mg %)	0.9	0.87	0.03
S. potassium (mEq/L)	4.1	4.2	0.1
S. sodium (mEq/L)	139.0	139.0	1.0
SGPT (Unit)	27.9	28.5	0.6
RBS (mg %)	109.2	107.5	1.7

Blood urea: 31.0±5.4→30.6±5.1, Creatinine: 0.9±0.12→0.87±0.10, Potassium: 4.1±0.25→4.2±0.22, Sodium: 139.0±2.1→139.0±2.0, SGPT: 27.9±6.5→28.5±6.3, RBS: 109.2±11.8→107.5±10.9. SGPT: Serum glutamic pyruvic transaminase, RBS: Random blood sugar

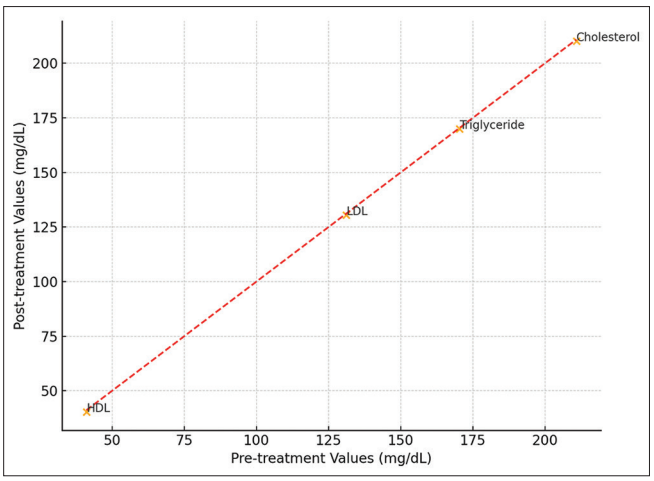

Fig. 2: Lipid profile: Pre versus post-treatment

among the ARBs studied. An important advantage of ARBs is their excellent tolerability profile. In our study, only one patient on olmesartan reported a mild headache, which was self-limiting and did not necessitate drug discontinuation. No cases of angioedema, cough (commonly associated with ACE inhibitors), hypotension, or electrolyte imbalance were reported. These findings align with prior studies highlighting ARBs as well-tolerated medications with a low incidence of adverse effects [15,16]. Clinical trials have consistently demonstrated that ARBs are among the most patient-friendly antihypertensive agents, often preferred in those intolerant to ACE inhibitors due to their lower risk of cough and angioedema [17].

There were no significant changes in renal function markers (blood urea, serum creatinine), liver enzymes, serum electrolytes, or RBS over the 3-month treatment period. The minimal changes observed in serum potassium and creatinine support the renal safety of ARBs, a finding previously corroborated by Koulouris *et al.* in diabetic populations [18]. Similarly, lipid parameters did not show significant variation during the study period; however, this observation may be confounded by

concurrent atorvastatin use in several patients, limiting the ability to attribute lipid stability solely to ARB therapy.

The mean pulse rate remained stable throughout the study period, indicating that ARBs did not exert significant chronotropic effects, consistent with the mechanism of action of this drug class. This observation aligns with the findings of Lezama-Martinez *et al*., who reported no significant effect of ARB therapy on heart rate in hypertensive patients [19]. Compliance was reported to be excellent, with all patients adhering to therapy and completing follow-up visits. This high adherence rate may reflect the once-daily dosing regimen, minimal side effects, and satisfactory BP control. The ESPRIT study by Sharma *et al*. reported similar adherence rates exceeding 97%, reinforcing the patient-friendly profile of ARBs [20].

Among the three ARBs, olmesartan emerged as the most potent in lowering BP, followed by telmisartan and losartan. However, all three agents were effective and safe as monotherapy in stage 1 hypertension. The decision to choose a specific ARB can be based on patient profile, cost, availability, and physician preference. Moreover, the absence of biochemical derangements or adverse effects highlights their long-term suitability in hypertensive management [7].

Limitations

The strengths of this study include its real-world applicability, systematic follow-up, and comparison among three commonly used ARBs. Limitations include the short follow-up period (3 months), small sample size, absence of a placebo or control group, and lack of blinding or randomization which could introduce bias. In addition some biochemical effects (e.g., on lipid profile) could not be fully attributed to ARBs due to concomitant statin therapy.

CONCLUSION

This study confirms that ARBs-specifically losartan, telmisartan, and olmesartan-are effective, safe, and well-tolerated options for the management of stage 1 hypertension in patients aged 40–60 years. Among the three, olmesartan demonstrated the greatest efficacy in reducing both systolic and DBPs, followed by telmisartan and losartan. No significant changes were observed in pulse rate, renal function, liver enzymes, blood glucose, or electrolyte levels, indicating the biochemical safety of ARBs. Only one minor adverse event (headache) was reported, highlighting the excellent tolerability profile of these drugs. Furthermore, patient compliance was high, with no dropouts or treatment discontinuations. In summary, ARBs can be considered a reliable first-line monotherapy for stage 1 hypertension, particularly in patients without compelling indications for other antihypertensive classes, and offer good BP control with minimal side effects.

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CONFLICTS OF INTEREST

No conflicts of interest.

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AUTHORS CONTRIBUTION

Both the authors equally contributed for the study.

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