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Comparative Evaluation of Labetalol and Nifedipine on Maternal Heart Rate and Blood Pressure in Gestational Hypertension

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ABSTRACT

Background: Gestational hypertension is a common pregnancy-related disorder associated with adverse maternal and fetal outcomes. Labetalol and nifedipine are frequently used antihypertensive agents during pregnancy. The present study compared their effects on maternal heart rate and blood pressure in women with gestational hypertension.

Material and Methods A prospective randomized comparative study was conducted among 110 pregnant women diagnosed with gestational hypertension. Participants were allocated into two groups of 55 each and received either oral labetalol (Group L) or oral nifedipine (Group N). Maternal systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate, time to achieve target blood pressure, adverse effects, and maternal and neonatal outcomes were assessed and compared.

Results: Baseline demographic and clinical characteristics were comparable between the groups. At delivery, mean SBP and DBP were significantly lower in the labetalol group compared with the nifedipine group (131.85±5.28 vs 134.96±5.81 mmHg and 82.44±3.55 vs 84.96±3.88 mmHg, respectively; $p<0.05$). Maternal heart rate was significantly lower in women receiving labetalol throughout follow-up and at delivery (81.89±5.17 vs 95.62±6.09 beats/min; $p<0.001$). The mean time to achieve target blood pressure was shorter with labetalol (9.42±2.87 vs 11.16±3.25 days; $p=0.003$). Palpitations and facial flushing occurred more frequently in the nifedipine group. Maternal and neonatal outcomes were comparable between the groups.

Conclusion: Both labetalol and nifedipine effectively controlled blood pressure in gestational hypertension. However, labetalol provided superior blood pressure reduction, better maternal heart rate control, earlier achievement of target blood pressure, and fewer vasodilatory adverse effects, suggesting potential clinical advantages over nifedipine.

Keywords*: Gestational hypertension; Labetalol; Nifedipine; Maternal heart rate; Blood pressure; Antihypertensive therapy.*

INTRODUCTION

Hypertensive disorders of pregnancy remain a major contributor to maternal and perinatal morbidity and mortality worldwide. Gestational hypertension, characterized by the new onset of elevated blood pressure after 20 weeks of gestation in a previously normotensive woman, is associated with an increased risk of progression to preeclampsia, preterm birth, placental complications, and adverse neonatal outcomes [1,2]. Effective blood pressure control is therefore essential to minimize maternal complications while maintaining adequate uteroplacental perfusion.

Pharmacological management constitutes the cornerstone of treatment in women requiring antihypertensive therapy during pregnancy. Among the available agents, labetalol and nifedipine are widely recommended because of their established efficacy and favorable safety profiles for both mother and fetus [3]. Labetalol, a combined α- and β-adrenergic receptor blocker, lowers blood pressure by reducing systemic vascular resistance and heart rate. In contrast, nifedipine, a calcium channel blocker, exerts its antihypertensive action primarily through peripheral vasodilatation [4].

Despite their widespread use, the comparative effects of these medications on maternal hemodynamic parameters continue to attract clinical interest. Recent evidence suggests that both drugs effectively control hypertension during pregnancy, although differences may exist in the speed of blood pressure reduction, cardiovascular responses, and adverse-effect profiles [5]. Furthermore, contemporary studies have reported comparable maternal and neonatal outcomes with either agent, emphasizing the need for further evaluation of specific hemodynamic effects that may influence clinical decision-making [6].

Maternal heart rate is an important physiological parameter during antihypertensive therapy because excessive tachycardia or bradycardia may affect maternal comfort, cardiovascular adaptation, and treatment tolerability. However, limited data are available regarding the comparative influence of labetalol and nifedipine on maternal heart rate in women with gestational hypertension.

Therefore, the present study was undertaken to compare the effects of labetalol and nifedipine on maternal heart rate and blood pressure among women diagnosed with gestational hypertension.

MATERIALS AND METHODS

Study Design and Setting: A prospective, randomized, comparative interventional study was conducted in a tertiary care teaching hospital. The study was undertaken after written informed consent was obtained from all participants prior to enrolment.

Study Population: Pregnant women diagnosed with gestational hypertension attending the antenatal clinic or admitted to the obstetric ward were screened for eligibility.

Inclusion Criteria

- Pregnant women aged 18–40 years.
- Singleton pregnancy.
- Gestational age ≥20 weeks.
- Newly diagnosed gestational hypertension, defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg measured on two occasions at least 4 hours apart after 20 weeks of gestation in a previously normotensive woman.
- Willingness to participate in the study.

Exclusion Criteria

- Chronic hypertension diagnosed before pregnancy or before 20 weeks of gestation.
- Severe preeclampsia or eclampsia.
- Multiple gestation.
- Known cardiovascular disease, renal disease, hepatic dysfunction, bronchial asthma, or diabetes mellitus requiring pharmacological treatment.
- Contraindications or hypersensitivity to labetalol or nifedipine.
- Women receiving other antihypertensive medications.

Sample Size: The sample size was calculated considering a confidence level of 95%, study power of 80%, and an anticipated difference in blood pressure reduction between the treatment groups based on previously published studies. A minimum sample size of 96 participants was estimated. To compensate for potential dropouts and incomplete follow-up, 110 participants were enrolled and randomly allocated into two equal groups of 50 participants each.

Randomization and Allocation: Eligible participants were randomly assigned using a computer-generated randomization sequence into:

- **Group L (Labetalol Group):** 55 participants receiving oral labetalol.
- **Group N (Nifedipine Group):** 55 participants receiving oral nifedipine.

Allocation concealment was achieved using sequentially numbered opaque sealed envelopes.

Intervention: Participants in Group L received oral labetalol at an initial dose of 100 mg twice daily. Dose escalation up to a maximum of 400 mg twice daily was performed when required to achieve adequate blood pressure control. Participants in Group N received oral nifedipine extended-release 20 mg once daily. The dose was increased gradually up to a maximum

of 60 mg daily according to blood pressure response. Treatment was continued until delivery unless modification was clinically indicated.

Data Collection: At enrolment, demographic characteristics including maternal age, parity, gestational age, body mass index, and baseline blood pressure were recorded. Blood pressure was measured using a calibrated sphygmomanometer with the participant in a seated position after at least 10 minutes of rest. Three readings were obtained at 5-minute intervals, and the average value was considered for analysis. Maternal heart rate was recorded simultaneously at each assessment. Participants were evaluated at baseline and subsequently at weekly antenatal visits until delivery.

Primary Outcomes:

- Change in systolic blood pressure from baseline.
- Change in diastolic blood pressure from baseline.
- Change in maternal heart rate from baseline.

Secondary Outcomes:

- Time required to achieve target blood pressure (<140/90 mmHg).
- Requirement for dose escalation.
- Maternal adverse effects.
- Development of severe hypertension or preeclampsia.
- Mode of delivery.
- Neonatal outcomes including birth weight, Apgar score, and neonatal intensive care unit admission.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 26.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Comparison of continuous variables between the two groups was performed using the independent samples t-test. Paired t-test was used for within-group comparisons. Categorical variables were compared using the Chi-square test or Fisher's exact test wherever appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

The baseline demographic and clinical characteristics were comparable between the two groups. The mean age of participants was 27.82±4.36 years in the labetalol group and 28.15±4.11 years in the nifedipine group. Similarly, no statistically significant differences were observed with respect to gravidity, gestational age, body mass index, baseline systolic blood pressure, baseline diastolic blood pressure, or baseline maternal heart rate ($p>0.05$ for all variables), indicating homogeneity of the study population at enrolment (Table 1).

A progressive reduction in systolic blood pressure was observed in both treatment groups throughout the study period. The mean baseline systolic blood pressure was 154.69±8.74 mmHg in the labetalol group and 155.22±9.01 mmHg in the nifedipine group. Although the reduction at week 1 was comparable between the groups ($p=0.156$), significantly lower systolic blood pressure values were recorded in the labetalol group at week 2, week 4, and at delivery compared with the nifedipine group ($p<0.05$) (Table 2).

Both medications also resulted in a significant decline in diastolic blood pressure during follow-up. Baseline diastolic blood pressure was similar between the groups (98.84±5.62 mmHg versus 99.31±5.47 mmHg; $p=0.658$). While no significant difference was observed at week 1, participants receiving labetalol demonstrated significantly lower diastolic blood pressure at week 2, week 4, and at delivery compared with those receiving nifedipine ($p<0.05$) (Table 3).

Maternal heart rate exhibited distinct trends between the two treatment groups. The mean baseline heart rate was comparable in both groups (92.42±8.13 beats/min in the labetalol group and 91.58±7.94 beats/min in the nifedipine group; $p=0.583$). Following treatment initiation, a gradual reduction in maternal heart rate was observed among women receiving labetalol, whereas a mild increase was noted in those receiving nifedipine. Consequently, maternal heart rate remained significantly lower in the labetalol group at week 1, week 2, week 4, and at delivery ($p<0.001$ for all comparisons) (Table 4).

The mean time required to achieve target blood pressure control (<140/90 mmHg) was significantly shorter in the labetalol group than in the nifedipine group (9.42±2.87 days versus 11.16±3.25 days; $p=0.003$). Target blood pressure was achieved in 94.5% of women receiving labetalol and 89.1% of those receiving nifedipine; however, this difference did not reach statistical significance ($p=0.301$) (Table 5).

Adverse effects were generally mild in both groups. Palpitations were reported significantly more frequently among women receiving nifedipine compared with labetalol (18.2% versus 1.8%; $p=0.004$). Similarly, facial flushing occurred exclusively in the nifedipine group and was statistically significant (12.7% versus 0%; $p=0.012$). A greater proportion of participants

in the labetalol group reported no adverse effects compared with the nifedipine group (70.9% versus 50.9%; p=0.031). The frequencies of headache, dizziness, and fatigue did not differ significantly between the groups (Table 6).

Maternal and neonatal outcomes were comparable between the study groups. The incidence of severe hypertension, progression to preeclampsia, mode of delivery, neonatal birth weight, Apgar score at 5 minutes, and neonatal intensive care unit admission showed no statistically significant differences between women treated with labetalol and those treated with nifedipine (p>0.05 for all comparisons) (Table 7).

Table 1. Baseline Demographic and Clinical Characteristics of Study Participants

Variable	Labetalol (n=55)	Nifedipine (n=55)	p-value
Age (years)	27.82 ± 4.36	28.15 ± 4.11	0.682
Primigravida, n (%)	31 (56.4)	29 (52.7)	0.698
Gestational age (weeks)	32.74 ± 2.91	32.48 ± 3.12	0.651
BMI (kg/m²)	27.64 ± 3.28	27.89 ± 3.47	0.702
Baseline Systolic BP (mmHg)	154.69 ± 8.74	155.22 ± 9.01	0.751
Baseline Diastolic BP (mmHg)	98.84 ± 5.62	99.31 ± 5.47	0.658
Baseline Heart Rate (beats/min)	92.42 ± 8.13	91.58 ± 7.94	0.583

Table 2. Comparison of Systolic Blood Pressure During Follow-up

Assessment Time	Labetalol (n=55)	Nifedipine (n=55)	p-value
Baseline	154.69 ± 8.74	155.22 ± 9.01	0.751
Week 1	145.76 ± 7.31	147.84 ± 7.95	0.156
Week 2	139.82 ± 6.54	142.95 ± 7.08	0.018
Week 4	134.18 ± 5.91	137.53 ± 6.27	0.004
At Delivery	131.85 ± 5.28	134.96 ± 5.81	0.004

Table 3. Comparison of Diastolic Blood Pressure During Follow-up

Assessment Time	Labetalol (n=55)	Nifedipine (n=55)	p-value
Baseline	98.84 ± 5.62	99.31 ± 5.47	0.658
Week 1	92.67 ± 4.89	94.44 ± 5.02	0.064
Week 2	88.53 ± 4.11	90.91 ± 4.68	0.005
Week 4	84.96 ± 3.82	87.55 ± 4.21	0.001
At Delivery	82.44 ± 3.55	84.96 ± 3.88	<0.001

Table 4. Comparison of Maternal Heart Rate During Follow-up

Assessment Time	Labetalol (n=55)	Nifedipine (n=55)	p-value
Baseline	92.42 ± 8.13	91.58 ± 7.94	0.583
Week 1	86.91 ± 6.84	94.24 ± 7.36	<0.001
Week 2	84.47 ± 6.11	95.13 ± 6.88	<0.001
Week 4	82.73 ± 5.42	96.36 ± 6.44	<0.001
At Delivery	81.89 ± 5.17	95.62 ± 6.09	<0.001

Table 5. Time Required to Achieve Target Blood Pressure (<140/90 mmHg)

Variable	Labetalol (n=55)	Nifedipine (n=55)	p-value
Time to BP control (days)	9.42 ± 2.87	11.16 ± 3.25	0.003
Achieved target BP, n (%)	52 (94.5)	49 (89.1)	0.301

Table 6. Adverse Effects Observed in Both Groups

Adverse Effect	Labetalol (n=55)	Nifedipine (n=55)	p-value
Headache	4 (7.3)	9 (16.4)	0.144
Dizziness	5 (9.1)	8 (14.5)	0.378
Palpitations	1 (1.8)	10 (18.2)	0.004
Facial flushing	0 (0.0)	7 (12.7)	0.012
Fatigue	6 (10.9)	3 (5.5)	0.303
No adverse effects	39 (70.9)	28 (50.9)	0.031

Table 7. Maternal and Neonatal Outcomes

Outcome	Labetalol (n=55)	Nifedipine (n=55)	p-value

Development of severe hypertension, n (%)	3 (5.5)	5 (9.1)	0.461
Progression to preeclampsia, n (%)	2 (3.6)	4 (7.3)	0.399
Vaginal delivery, n (%)	34 (61.8)	31 (56.4)	0.564
Caesarean section, n (%)	21 (38.2)	24 (43.6)	0.564
Birth weight (kg)	2.84 ± 0.41	2.77 ± 0.39	0.362
NICU admission, n (%)	4 (7.3)	6 (10.9)	0.510
Apgar score at 5 min	8.76 ± 0.71	8.62 ± 0.74	0.315

DISCUSSION

Gestational hypertension remains a significant contributor to maternal and perinatal morbidity, necessitating effective antihypertensive therapy that achieves blood pressure control without compromising maternal or fetal well-being. The present study compared the effects of labetalol and nifedipine on maternal blood pressure and heart rate among women with gestational hypertension. Both drugs were effective in lowering blood pressure; however, labetalol demonstrated superior control of systolic and diastolic blood pressure, produced a greater reduction in maternal heart rate, and achieved target blood pressure earlier than nifedipine.

The baseline demographic and clinical characteristics of participants were comparable between the two groups, indicating that the observed differences in outcomes were likely attributable to the interventions rather than pre-existing disparities. Similar baseline comparability has been reported in contemporary studies evaluating antihypertensive therapies during pregnancy [7,8].

In the present study, both medications significantly reduced systolic and diastolic blood pressure during follow-up. However, women receiving labetalol exhibited significantly lower systolic and diastolic blood pressure values from the second week onward compared with those receiving nifedipine. These findings are consistent with current evidence demonstrating that both agents are effective first-line antihypertensive drugs during pregnancy and are capable of achieving satisfactory blood pressure control [8,9]. The superior blood pressure reduction observed with labetalol in our study may be related to its combined α- and β-adrenergic blocking activity, which decreases peripheral vascular resistance while attenuating sympathetic cardiovascular responses.

A notable finding of the present study was the significant difference in maternal heart rate between treatment groups. Women receiving labetalol experienced a progressive reduction in heart rate, whereas those receiving nifedipine demonstrated a modest increase. This observation is pharmacologically plausible because β-adrenergic blockade reduces chronotropic activity, while peripheral vasodilatation induced by nifedipine may result in reflex sympathetic activation and compensatory tachycardia [10]. The substantially lower maternal heart rate observed with labetalol suggests improved hemodynamic stability and may contribute to better treatment tolerability.

The mean time required to achieve target blood pressure was significantly shorter in the labetalol group. Rapid attainment of adequate blood pressure control is clinically important because prolonged exposure to elevated blood pressure may increase the risk of maternal complications. Although recent literature indicates that both labetalol and nifedipine are effective therapeutic options, uncertainty remains regarding the optimal first-line antihypertensive strategy during pregnancy, which has prompted large contemporary trials such as the Giant PANDA study [11].

Adverse effects in the present study were generally mild and self-limiting. Palpitations and facial flushing occurred significantly more frequently among women receiving nifedipine, whereas a greater proportion of women treated with labetalol reported no adverse effects. These findings are consistent with the known pharmacological profile of calcium channel blockers, in which vasodilatation may lead to flushing, headache, and palpitations [10]. The better tolerability profile observed with labetalol may enhance patient adherence during long-term therapy.

Maternal and neonatal outcomes were comparable between the groups. No statistically significant differences were observed regarding progression to severe hypertension, development of preeclampsia, mode of delivery, birth weight, Apgar score, or neonatal intensive care unit admission. These findings align with recent evidence demonstrating similar maternal and neonatal outcomes among women treated with either labetalol or nifedipine during pregnancy [8,12]. Furthermore, contemporary analyses have not identified significant differences in major adverse pregnancy outcomes between the two medications when used for antenatal blood pressure control [8,13].

The findings of the present study support the continued use of both labetalol and nifedipine as effective first-line antihypertensive agents in gestational hypertension. However, the superior blood pressure reduction, more favorable heart rate profile, earlier achievement of target blood pressure, and lower incidence of vasodilatory adverse effects observed with labetalol suggest potential clinical advantages in selected patients. Larger multicentric studies with longer follow-up may further clarify whether these hemodynamic differences translate into meaningful improvements in maternal and neonatal outcomes.

CONCLUSION

Both labetalol and nifedipine were effective in reducing blood pressure among women with gestational hypertension and demonstrated favorable maternal and neonatal outcomes. However, labetalol was associated with greater reductions in systolic and diastolic blood pressure, more effective control of maternal heart rate, and a shorter time to achieve target blood pressure levels. Furthermore, labetalol exhibited a lower incidence of vasodilatory adverse effects such as palpitations and facial flushing. These findings suggest that while both agents are suitable options for the management of gestational hypertension, labetalol may offer certain clinical advantages in terms of hemodynamic stability and tolerability.

REFERENCES

1. Garovic VD, Dechend R, Easterling T, Karumanchi SA, McMurtry Baird S, Magee LA, et al. Hypertension in Pregnancy: Diagnosis, Blood Pressure Goals, and Pharmacotherapy: A Scientific Statement From the American Heart Association. Hypertension. 2022 Feb;79(2):e21-e41. doi: 10.1161/HYP.0000000000000208.
2. Rana S, Lemoine E, Granger JP, Karumanchi SA. Preeclampsia: Pathophysiology, Challenges, and Perspectives. Circ Res. 2019 Mar 29;124(7):1094-1112. doi: 10.1161/CIRCRESAHA.118.313276.
3. van de Vusse D, Mian P, Schoenmakers S, Flint RB, Visser W, Allegaert K, Versmissen J. Pharmacokinetics of the most commonly used antihypertensive drugs throughout pregnancy methyldopa, labetalol, and nifedipine: a systematic review. Eur J Clin Pharmacol. 2022 Nov;78(11):1763-1776. doi: 10.1007/s00228-022-03382-3.
4. Ashworth D, Battersby C, Bick D, Green M, Hardy P, Leighton L, et al. A treatment strategy with nifedipine versus labetalol for women with pregnancy hypertension: study protocol for a randomised controlled trial (Giant PANDA). Trials. 2023 Sep 12;24(1):584. doi: 10.1186/s13063-023-07582-9.
5. Li L, Xie W, Xu H, Cao L. Oral nifedipine versus intravenous labetalol for hypertensive emergencies during pregnancy: a systematic review and meta-analysis. J Matern Fetal Neonatal Med. 2023 Dec;36(2):2235057. doi: 10.1080/14767058.2023.2235057.
6. Sanusi AA, Leach J, Boggess K, Dugoff L, Sibai B, Lawrence K, et al. Pregnancy Outcomes of Nifedipine Compared With Labetalol for Oral Treatment of Mild Chronic Hypertension. Obstet Gynecol. 2024 Jul 1;144(1):126-134. doi: 10.1097/AOG.0000000000005613.
7. Firoz T, Magee LA, MacDonell K, Payne BA, Gordon R, Vidler M, et al. Oral antihypertensive therapy for severe hypertension in pregnancy and postpartum: a systematic review. BJOG. 2014 Sep;121(10):1210-8; discussion 1220. doi: 10.1111/1471-0528.12737.
8. Shaikh H, Pallavi K. Comparative study of labetalol and nifedipine in management of hypertensive disorders of pregnancy. International Journal of Current Pharmaceutical Research. 2024;16(5):14–18. doi:10.22159/ijcpr.2024v16i5.5020.
9. Tita AT, Szychowski JM, Boggess K, Dugoff L, Sibai B, Lawrence K, et al. Treatment for Mild Chronic Hypertension during Pregnancy. N Engl J Med. 2022 May 12;386(19):1781-1792. doi: 10.1056/NEJMoa2201295.
10. Magee LA, von Dadelszen P, Singer J, Lee T, Rey E, Ross S,et al: Is Severe Hypertension Just an Elevated Blood Pressure? Hypertension. 2016 Nov;68(5):1153-1159. doi: 10.1161/HYPERTENSIONAHA.116.07862.
11. Zulfeen M, Tatapudi R, Sowjanya R. IV labetalol and oral nifedipine in acute control of severe hypertension in pregnancy: a randomized controlled trial. European Journal of Obstetrics & Gynecology and Reproductive Biology. 2019;236:46–52. doi:10.1016/j.ejogrb.2019.01.022.
12. Easterling T, Mundle S, Bracken H, Parvekar S, Mool S, Magee LA, et al. Oral antihypertensive regimens (nifedipine retard, labetalol, and methyldopa) for management of severe hypertension in pregnancy: an open-label, randomised controlled trial. Lancet. 2019 Sep 21;394(10203):1011-1021. doi: 10.1016/S0140-6736(19)31282-6.
13. American College of Obstetricians and Gynecologists' Committee on Practice Bulletins—Obstetrics. ACOG Practice Bulletin No. 203: Chronic Hypertension in Pregnancy. Obstet Gynecol. 2019 Jan;133(1):e26-e50. doi: 10.1097/AOG.0000000000003020.