

Effects of Different Antihypertensive Drugs on Systolic and Diastolic Blood Pressure, Heart Rate and Lipid Profile

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Introduction

- Hypertension (HTN) or high blood pressure is a chronic medical condition in which the systemic arterial blood pressure is elevated. It is the opposite of hypotension. It is classified as either primary (essential) or secondary. About 90–95% of cases are termed “primary hypertension”, which refers to high blood pressure for which no medical cause can be found. The remaining 5–10% of cases (Secondary hypertension) are caused by other conditions that affect the kidneys, arteries, heart, or endocrine system.

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- Hypertension is defined as a systolic blood pressure of 140 mm Hg or higher and/or diastolic blood pressure of 90 mm Hg or greater. When the systolic blood pressure ranges between 140-159 and the diastolic blood pressure ranges between 90 – 99, hypertension is considered mild.
- Moderate hypertension is labeled when the systolic blood pressure ranges from 160 – 179 and diastolic blood pressure ranges from 100-109. When the systolic blood pressure is ≥ 180 and diastolic blood pressure is ≥ 110 it is considered as severe.

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- Antihypertensive drug treatment with special reference to the drugs used in this study:
- Calcium Channel Blockers (Amlodipine) is a dihydropyridine calcium antagonist (calcium ion antagonist or slow-channel blocker) that inhibits the transmembrane influx of calcium ions into vascular smooth muscle and cardiac muscle. Amlodipine inhibits calcium ion influx across cell membranes selectively, with a greater effect on vascular smooth muscle cells than on cardiac muscle cells.
- Angiotensin Converting Enzyme Inhibitors (ACEI): provide multiple benefits to the heart without the potential of any adverse effect on the heart . The benefits of ACE inhibitors include the greatest degree of LVH regression, improvement in coronary flow reserve improvement in coronary vasomotor responses relief of angina in some patients. In addition reduction of mortality following myocardial infarction and inhibition of atherosclerosis in animal models enalapril is effective in promoting regression of LVH in hypertensive patients and improving LV diastolic function.

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- Beta blockers : are reducing the overall morbidity and mortality in patients with hypertension. Moreover they are effective in promoting LVH regression in hypertensive patients.
- Atenolol is a beta selective adrenoceptor blocker that is appropriate for initiation as well as subsequent therapy for all degrees of hypertension, documented that atenolol to be effective in causing regression of LVH in hypertensive patients and improve LV diastolic function.

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Aims of the study

- The present study was undertaken to assess and compare the effects of the beta₁-adrenoceptor blocker (atenolol), the angiotensin-converting enzyme inhibitor (enalapril) and the calcium channel blocker (amlodipine) monotherapy in patients with mild-moderate hypertension, Changes in serum lipid profile

Patients and Method

- Two hundred consecutive hypertensive patients (average age 50 ± 15 years) and one hundred normotensive controls (55 ± 15 years) attending the many teaching hospital and private clinic in BAGHDAD city/Iraq in the period between 2018 and 2020 were included in this study.
- In all patients, supine BP was measured by a mercury sphygmomanometer using the first and fifth Korotkoff sounds to identify systolic and diastolic values, respectively. The average of three measurements was used as the clinic blood pressure.

- - Patients included in the study were allocated randomly into 3 equal groups each of 300 patients as:
 - Group I received atenolol tablet ` (50-100 mg once daily).
 - Group II received enalapril tablet Enopril, (10-20 mg once daily).
 - Group III received amlodipine tablet amlong, (5-10 mg once daily).
 - The drug doses were titrated to keep blood pressure consistently below 140/90. These patients together with the normotensive controls were studied and followed for 3 months, Hypertensive patients and the normotensive controls. Biochemical studies: The following biochemical tests were performed for each patient at the initial visit and repeated after the study period: serum lipid profile including total cholesterol, LDL cholesterol, HDL cholesterol, and serum triglycerides .

Results

- Two hundred hypertensive patients and one hundred normotensive controls were enrolled into the study. A number of the above mentioned hypertensives and controls discontinued the study without an obvious reason, sixty five patients treated with atenolol (44 M and 21 F), sixty patients treated with enalapril (53 M and 17 F), eighty patients treated with amlodipine (60 M and 20 F) and eighty five control (77 M and 8 F). The mean age of hypertensive patients was 50 ± 15 years versus 50 ± 15 years in the control group. Baseline serum lipid levels showed a significantly higher total cholesterol levels, and a significantly less HDL cholesterol levels in hypertensive patients as compared to normotensive controls.

- Effects of treatment on blood pressure, heart rate: Patients taking atenolol showed a significant reduction of SBP, heart rate & see Table (1) figure (1,2,3).
- Table (1): Effects of atenolol, enalapril, amlodipine on blood pressure, heart rate .

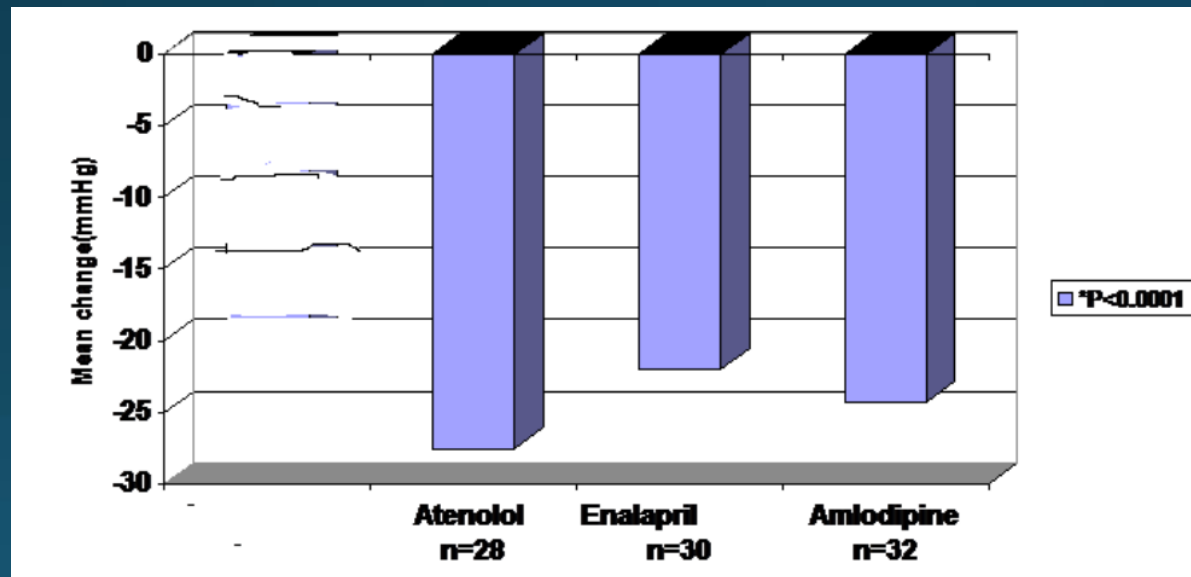
Blood pressure & Heart rate	Atenolol (50-100 mg daily)		Enalapril (10-20 mg daily)		Amlodipine (5-10 mg daily)	
	Before treatment (Mean± S.D)	After 3 months treatment (Mean± S.D)	Before treatment (Mean± S.D)	After 3 months treatment (Mean± S.D)	Before treatment (Mean± S.D)	After 3 months treatment (Mean± S.D)
Systolic blood pressure, mm H g	163.57±2.42	136.07±0.079	157.50±1.43	135.50±0.77	159.69±2.02	135.331±0.744
Diastolic blood pressure, mm H g	95.71±0.71	80.18±0.79	97.17±0.57	80.50±0.65	97.03±0.59	81.56±0.85
Heart rate, beat/minute	78.79±87	60.04±0.10	78.47±0.96	78.90±0.79	79.13±0.999	77.91±0.76

- The group taking enalapril showed a significant reduction of SBP, DBP, while there was no significant change in heart rate. So, the amlodipine-treated patients showed a significant decrease of SBP, DBP whereas the change in heart rate was not significant. In the normotensive control group, no significant changes were observed in SBP, DBP, heart rate after the 3 months follow-up period. See & see Table (2) and figure(1,2,3)

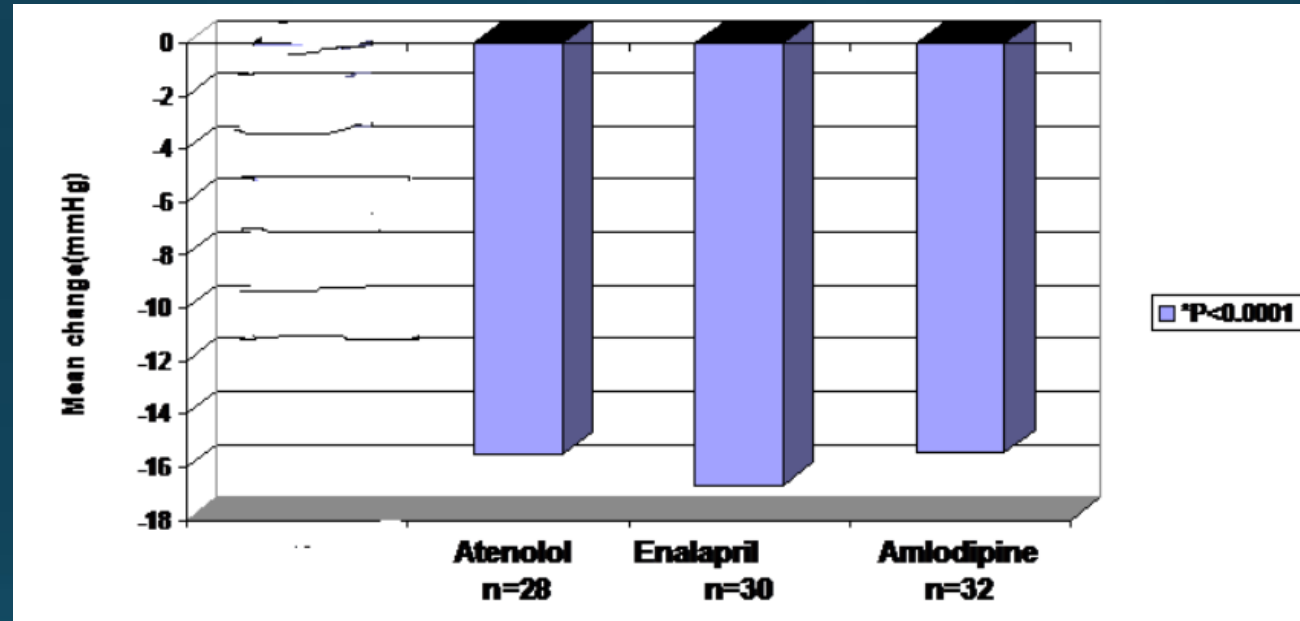
Table (2): Blood pressure, heart rate in normotensive control subjects

Blood pressure & Heart rate	At base line	At 3 months
Systolic blood pressure, mm Hg	123.7± 1.55	124.65±1.32
Diastolic blood pressure, mm Hg	78.552± 0.9	79.83± 4.47
Heart rate, beat/minute	75.87 ± 0.85	75.39 ± 0.79

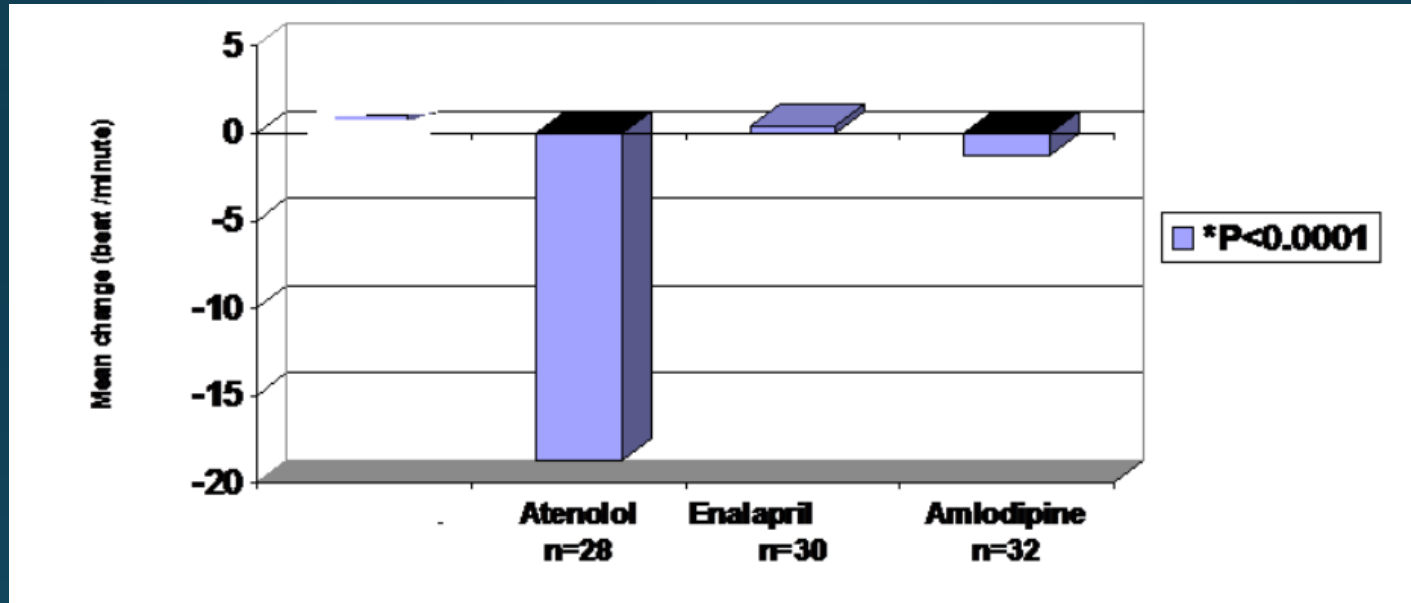
- Comparisons among treated groups for changes from base line with that after 3 months treatment in mean SBP, DBP, Heart rate revealed no significant differences between the effects of atenolol, enalapril and amlodipine on SBP and DBP & see figure (1,2,3).



- Figure 1: Mean change in systolic blood pressure (mmHg) after 3 months treatment with daily atenolol (50- 100mg), enalapril (10-20 mg), and amlodipine (5-10 mg).



- Figure 2: Mean change in diastolic blood pressure (mmHg) after 3 months treatment with daily atenolol (50- 100mg), enalapril (10-20 mg),and amlodipine (5-10 mg).



- Figure 3: Mean change in heart rate (beat/minute) after 3 months treatment with daily atenolol (50-100mg), enalapril (10-20 mg), and amlodipine (5-10 mg)

- Effects of treatment on serum lipid profile: In the atenolol-treated group no statistically significant changes were noted in serum lipid levels after 3 months of treatment (Table 3)
- Table (3): Effects of atenolol, enalapril and amlodipine on serum lipid profile

Serum lipid profile	Atenolol (50-100mg daily)		Enalapril (10-20 mg daily)		Amlodipine (5-10 mg daily)	
	Before treatment (Mean± S.D)	Before treatment (Mean± S.D)	After 3 months treatment (Mean± S.D)	After 3 months treatment (Mean± S.D)	Before treatment (Mean± S.D)	After 3 months treatment (Mean± S.D)
Total cholesterol, mg/dl	194.43±6.70	200.9±8.39	198.0±8.20	193.07±7.00	197.72±7.27	190.78±7.20
LDL- cholesterol, mg/dL	121.61±5.60	128.83±7.93	125.47±7.56	120.68±5.90	129.91±6.59	122.28±6.67
HDL- cholesterol, mg/dL	36.32±1.4	39.40±1.43	41.73±1.32	34.93±0.96	38.88±1.02	39.53±0.91
Triglycerides, mg/dL	184.36±13.10	155.57±12.28	155.60±11.52	186.61±12.50	141.75±9.87	142.63±9.76

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- After 3 months of treatment the total cholesterol level was reduced by enalapril but not significantly while HDL cholesterol level was significantly elevated .
- In the amlodipine treated group a significant reduction was found in serum total cholesterol level and a significant decreases were found in serum LDL levels while the changes in serum HDL cholesterol and serum triglyceride levels were not statistically significant, Amlodipine was significantly better than atenolol and enalapril at reducing total cholesterol level.
- Amlodipine was significantly better than atenolol and enalapril at reducing LDL cholesterol level. Enalapril was significantly better than amlodipine and atenolol at increasing serum HDL level.

Discussion

- In this study .compare between antihypertensive drugs & we take three kinds which are atenolol, enalapril, or amlodipine and effect on patient significant increases in heart rate, SBP,DBP and subsequently mean arterial BP were observed in both hypertensives and normotensive control group . Concerning serum lipid levels , it was shown that hypertensive patients had a significantly higher total cholesterol levels and significantly less HDL cholesterol levels as compared to normotensive controls . These findings are consistent with that reported by Claudio Marone, 2001)9 . It reflects the common association of hypertension with dyslipidaemia (Hunninghake, 1991).

- • Effects of therapy on blood pressure and heart rate: The systolic and diastolic BP values were significantly reduced after, atenolol, enalapril, or amlodipine therapy .
- The anti-hypertensive efficacy of these drugs in patients with mild to moderate hypertension was comparable as was shown in earlier studies (Karlberg et al., 1999, Thurmann 1998). There was no significant change in heart rate in patients taking, enalapril, or amlodipine which is consistent with that reported elsewhere (Karlberg et al., 1999). On the other hand heart rate was significantly reduced by atenolol which was expected from its beta blocking effect. Effects of therapy on serum lipids Hypertension commonly occurs in association with dyslipidemia and atherosclerosis.
- In the enalapril treated group a significant increase of HDL cholesterol was found and this support the view that ACE inhibitors have a beneficial effects on lipid metabolism (Hunninghake, 1991)

- The favorable lipid changes observed with amlodipine, namely a significant decrease of total cholesterol and LDL cholesterol levels are in agreement with that reported by (Stein et al., 1991; Richard et al., 1996) have suggested that calcium channel blockers especially amlodipine cause up regulation of LDL receptors in the liver with enhanced LDL clearance .
- Beta₁ selective blockers like atenolol may induce a shift toward a more atherogenic lipid profile namely a decrease of HDL cholesterol and an increase of LDL cholesterol .These effects are attributed to the inhibition of lecithin cholesterol acyl transferase (LCAT) enzyme and decrease in hepatic LDL receptors (pesant et al., 1999) by these drugs .
- Our study did not document statistically significant adverse effects of atenolol on serum lipid levels. In fact, there was a decrease of HDL cholesterol but the reduction was not statistically significant

Conclusion

- Patients taking atenolol showed a significant reduction of SBP, heart rate & The group taking enalapril showed a significant reduction of SBP, DBP, while there was no significant change in heart rate . The amlodipine –treated patients showed a significant decreases of SBP, DBP whereas the change in heart rate was not significant. Concerning the effects on serum lipid profile the following favorable changes were observed : HDLcholesterol was significantly increased by enalapril while LDL-cholesterol and Total cholesterol was significantly reduced by amlodipine . The amlodipine are to be prefaerred in hypertensive patients with elevated LDL-cholesterol levels .On the other hand, enalapril is valuable in hypertensive patients with low HDLcholesterol levels.

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