

# The impact of antihypertensive medication class on pulse pressure

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## ABSTRACT

**Background :** Hypertension with high pulse pressure causes more arterial damage compared to high blood pressure with normal pulse pressure .

**Objective:** This is a cross section descriptive study carried out to explore the efficacy of different antihypertensive therapies using the pulse pressure as a predictor of better response and show the associations between antihypertensive medication class and the magnitude of pulse pressure among persons receiving treatment for hypertension.

**Patients and methods:** 921 hypertensive patients on different antihypertension medication classes who attending An Nasiriyah General Hospital out patients over 6 months are examined to determined their pulse pressure and compared the results of different groups according to age of the patients and antihypertension medication classes.

**Results:** hypertensive subjects who used diuretics alone or in combination with beta-blockers had lower mean pulse pressure as compared with those using other agents and this finding is so clear and statically significant among patients older than 60 with no sex difference.

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## INTRODUCTION

Formally pulse pressure defines as the systolic pressure minus the diastolic pressure. <sup>[1]</sup> Theoretically, the pulse pressure can be conceptualized as stroke volume X compliance. For instance, even though the right and left ventricles have similar stroke volumes, because the aorta is the most compliant vessel (due to the large amount of elastic fibers) the aortic pulse pressure is much greater than the pulmonary pulse pressure. <sup>[2]</sup> Usually, the resting pulse pressure in healthy adults, sitting position, is about 40 mmHg. The pulse pressure increases with exercise due to increased stroke volume, healthy values being up to pulse pressures of about 100 mmHg, simultaneously as total peripheral

resistance drops during exercise. In healthy individuals the pulse pressure will typically return to normal within about 10 minutes. <sup>[3]</sup>

For most individuals, during exercise, the systolic pressure progressively increases while the diastolic remains about the same. In some very aerobically athletic individuals, the diastolic will progressively fall as the systolic increases. This behavior facilitates a much greater increase in stroke volume and cardiac output at a lower mean arterial pressure and enables much greater aerobic capacity and physical performance. The diastolic drop reflects a much greater fall in total peripheral resistance of the muscle arterioles in response to the exercise. If the usual resting pulse pressure is consistently

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greater than 40 mmHg, e.g. 60 or 80 mmHg, the most likely basis is stiffness of the major arteries, aortic regurgitation, arteriovenous malformation, hyperthyroidism or some combination. Some drugs for hypertension have the side effect of increasing resting pulse pressure irreversibly. A high resting pulse pressure is harmful and tends to accelerate the normal ageing of body organs, particularly the heart, the brain and kidneys.<sup>[4]</sup> Recent work suggests that a high pulse pressure is an important risk factor for heart disease.<sup>[2]</sup> For these reasons, a blood pressure of 160/60 mm Hg (pulse pressure Of 100 mmHg) carries twice the risk of fatal coronary heart disease as 150/110 mm Hg (pulse pressure of 40 mmHg)<sup>[5]</sup>. This helps to explain the apparent increase in risk sometimes associated with low diastolic pressure, and warn that some medications for high blood pressure may actually increase the pulse pressure and the risk of heart disease.<sup>[6]</sup> Several studies have identified that high pulse pressure:<sup>[6, 7 and 8]</sup>

- Causes more artery damage compared to high blood pressure with normal pulse pressure
- Indicates elevated stress on a part of the heart called the left ventricle
- Is affected differently by different antihypertensive medications.

In the United States, investigators have examined the prognostic value of pretreatment pulse pressure and found it to be an accurate predictor of myocardial infarction. Results of several longitudinal studies in older patients with hypertension indicate that a high pulse pressure is a sensitive marker for carotid artery stenosis, which increases the risk of stroke, coronary heart disease, and sudden death.<sup>[8]</sup> The purpose of this

study was to examine the associations between antihypertensive medication class and the magnitude of pulse pressure among persons receiving treatment for hypertension in An-Nasiriyah governorate in the south of Iraq

## *PATIENTS AND METHODS*

From September 2007 to March 2008, among hypertensive adult patients (age range from 18 to 79) who attended out patients clinic in An-Nassirryha General Hospital for follow their blood pressure control, we asses their blood pressure using mercury sphygmomanometer, at sitting position, 3-4 hours after their morning antihypertensive dose, tow measurements are done three minutes apart and the mean of them was obtained, all patients included in the study should have hypertension per se and regularly taken their treatment for at least six months who reported receiving one or two hypertensive drugs from the following medication classes: beta-blockers, diuretics, calcium channel blockers, or angiotensin-converting enzyme inhibitors. Patients with history of myocardial infarction, Cerbrovascular accident, chronic renal failure or heart failure are excluded from the study; other exclusion criteria include common causes of wide pulse pressure like thyrotoxicosis, pregnancy, aortic regurgitation and arteriovenous malformation. Those with irregular treatment or with three drugs combination are not included in the study also those who presented with hypertensive emergencies are not included 921 Patients are included in the study and they are subdivided into 3 groups according to their age (under 40, 40-60 and older then 60 years) and pulse pressure was determined to all of them and the mean of the measurements was determined for different antihypertensive therapies groups included in the study.

## RESULTS

Pulse pressure was found to be lower in those who are using diuretics alone or combination of diuretics and beta blockers compared to other agents (47.59 and 48.321 versus 52.867 for BB, 58.599 for ACEI, 61.736 for Calcium channel blocker and 55.374 for ACEI and Diuretics). This finding is so clear among those older than 40 year compared to younger patients in whom there's no significant difference in pulse pressure in relation to antihypertensive agents class. There are no sex differences in pulse pressure in all age groups with different antihypertensive agent's class.

## DISCUSSION

Widened pulse pressure is an independent predictor of cardiovascular outcomes in older persons.<sup>[9]</sup> This fact indicate the importance of maintaining low pulse pressure as a significant aim of therapy in hypertensive patients<sup>[10]</sup>; in other hands, pulse pressure may be considered as an important guide to predict high risk group hypertensive patient and a one of predictors of response to antihypertensive therapy, so it can be used to assess their efficacy.<sup>[11]</sup> Epidemiological studies have demonstrated that pulse pressure elevation directly correlates with cardiovascular mortality and morbidity, as well as with target organ damage.<sup>[8, 9, 11 and 12]</sup> In this study we found that most of the hypertensive patients who attended An –Nassirryha Teaching hospital not concentrate on their pulse pressure mostly due to lack of information about this fact. In this study we found that's 63.63% have significant high pulse pressure (50 mm Hg is likely the reference value for clinically significant pulse pressure in both men and women) [15] with increasing frequency with age (79.24% of patients older than 60 years

versus 48.32% of those younger than 40 years). This is probably related to stiffening of blood vessels. These finding high lights the importance of farther studies on this issue due to its prognostic value. Similar to other studies<sup>[6, 9 and 11]</sup> pulse pressure was markedly elevated among those older than 60 years compared to those under 40 years of age (58.658 mm Hg versus 48.658 mm Hg ) this reflect the higher incidence of what is previously known as isolated systolic hypertension among older population.<sup>[7]</sup> significant differences between BB and diuretics in those younger than 40 years ( 47.018 and 47.834 This study shows that's diuretics (alone or combined to BB) significantly associated with lower mean pulse pressure (47.59 mmHg and 48.32 mmHg respectively) compared with other agents especially in older age but no mm Hg respectively ) while diuretics alone or combined with BB are associated with lowering of pulse pressure by (7.307 and 7.126 mmHg respectively ) from the mean pulse pressure among patients older than 60 years age . This study will hopefully help us learn more about the best way to look at blood pressure in patients. "Researchers are starting to get the idea that it is important to look at both the top and bottom numbers and how they relate to one another when studying blood pressure. It's not just the top number by itself or the bottom number by itself that matters. It may be the relationship between the numbers -- the distance between them -- that gives important information . ACEI are not widely used in young (child bearing age) female and most of the patient used monotherapy rather than combination therapy. Older age patients have higher mean pulse pressure but among them lower mean pulse pressure achieved with those who used diuretics alone or combined with beta blockers

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**Table 1 : Distribution of patients by age and sex**

Anti hypertensive class	age ( <40 )y.			age (40-60)y.			age (> 60)y.			Total		
	♂	♀	total	♂	♀	total	♂	♀	total	♂	♀	Total
<b>BB</b>	31	26	57	44	39	83	38	33	71	113	98	221
<b>ACEI</b>	23	8	31	37	34	71	42	38	80	102	80	182
<b>Diuretics</b>	14	16	30	30	32	62	39	35	74	83	83	166
<b>BB&amp; Diuretics</b>	7	11	18	25	29	54	32	30	62	64	70	134
<b>Calcium channel blocker</b>	7	6	13	29	26	55	24	29	53	60	61	121
<b>ACEI &amp;Diuretics</b>	0	0	0	25	27	52	27	28	55	52	55	107
<b>Total</b>	82	67	149	190	187	377	202	193	395	474	447	921

**F = 14.579**

**df= 2**

**p= 0.0001**

**Table2: Mean Pulse pressure(mm Hg)by age &antihypertensive agents' class**

Antihypertensive class	age ( <40 )y..	age (40-60)y.	age (> 60)y.	Total
BB	47.018	49.337	61.69	52.867
ACEI	51.129	55.211	64.5	58.599
Diuretics	47.834	42.984	51.351	47.59
BB& Diuretics	48.056	44.722	51.532	48.321
Calcium channel blocker	52.692	60	65.755	61.736
ACEI & Diuretics	—	53.365	57.273	55.374
Total	48.658	50.849	58.658	53.844

**F= 2.830**

**df= 2**

**p= 0.09**

**Table: 3 Distribution of pulse pressure in males according to age & antihypertensive agents' class**

Anti hypertensive medications class	age (<40)y.		age (40-60)y.		age (> 60)y.		Total	
	significant high*	Not significant	significant high*	Not significant	significant high*	Not significant	significant high*	Not significant
BB	10	21	22	22	34	4	66	47
ACEI	11	12	24	13	38	4	73	29
Diuretics	6	8	9	21	22	17	37	46
BB& Diuretics	4	3	8	17	19	13	31	33
Calcium channel blocker	6	1	20	9	22	2	48	12
&ACEI Diuretics	—	—	16	9	23	4	39	13
<b>Total</b>	<b>37</b>	<b>45</b>	<b>99</b>	<b>91</b>	<b>158</b>	<b>44</b>	<b>294</b>	<b>180</b>

significant high pulse pressure ( $\geq 50$ mm Hg)

F= 15.111

df= 2

p= 0.0001

[6]

**Table 4 :distributions of pulse pressure in females according to age and antihypertensive agents' class**

Anti hypertensive medication s class	age (<40)y.		age (40-60)y.		age (> 60)y.		Total	
	significant high*	Not significant	significant high*	Not significant	significant high*	Not significant	significant high*	Not significant
BB	12	14	22	17	30	3	64	34
ACEI	6	2	25	9	36	2	67	13
Diuretics	8	8	6	26	19	16	33	50
BB& Diuretics	5	6	6	23	19	11	30	40
Calcium channel blocker	4	2	23	3	27	2	54	7
ACEI & Diuretics	—	—	20	7	24	4	44	11
<b>Total</b>	<b>35</b>	<b>32</b>	<b>102</b>	<b>85</b>	<b>155</b>	<b>38</b>	<b>292</b>	<b>155</b>

F= 1.042

df = 2

p= 0.377

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**Table: 5 Distributions pulse pressure according to age &antihypertensive agents' class**

Anti hypertensive medications class	age ( <40 )y.		age (40-60)y.		age (> 60)y.		Total	
	significant high*	Not significant	significant high*	Not significant	significant high*	Not significant	significant high*	Not significant
<b>BB</b>	22	35	44	39	64	7	130	91
<b>ACEI</b>	17	14	49	22	74	6	140	42
<b>Diuretics</b>	14	16	15	47	41	33	70	96
<b>BB&amp; Diuretics</b>	9	9	14	40	38	24	61	73
<b>Calcium channel blocker</b>	10	3	43	12	49	4	102	19
<b>ACEI &amp; Diuretics</b>	—	—	36	16	47	8	83	24
<b>Total</b>	72	77	201	176	313	82	586	335

\* *Significant high pulse pressure ( $\geq 50$ mm Hg)* <sup>[6]</sup>

**F= 14. 937**

**df = 2**

**p= 0.0001**

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## تأثير أصناف العقاقير المضادة لفرط الضغط على الضغط النبضي

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### ملخص البحث:

**تمهيد :** فرط ضغط الدم المصحوب بضغط نبضي عالي يسبب ضررا شريانيا أكبر من ذلك الذي يسببه ارتفاع ضغط الدم المقرون بضغط نبضي طبيعي.

**الهدف:** تهدف هذه الدراسة لأستطلاع مدى فعالية العقاقير المستخدمة لعلاج فرط الضغط مستخدمة الضغط النبضي كمؤشر للأستجابة الأفضل وعرض العلاقة بين أصناف الأدوية المضادة لأرتفاع ضغط الدم والضغط النبضي بين مرضى فرط الضغط

**الطريقة :** شملت الدراسة ٩٢١ مريضا مصابا بارتفاع ضغط الدم يتعاطون عقاقير مختلفة من تلك المستعمله لعلاج فرط الضغط ممن راجعوا العيادة الخارجية في مستشفى الناصرية العام وعلى مدى ستة أشهر تم فحصهم وقياس ضغط الدم وأحتساب معدل الضغط النبضي لكل منهم ومقارنة النتائج حسب العمر وصنف الأدوية التي يتعاطونها.

**النتائج:** أظهرت الدراسة أن معدلات الضغط النبضي أقل لدى المرضى الذين يستخدمون المدررات لوحدها أو مع مثبطات بيتا وهذه الحصيلة أكثر وضوحا وذات قيمه إحصائية أكثر لدى المرضى الذين تزيد أعمارهم عن ٦٠ سنة ولم يلاحظ فرق بين الجنسين.