

Profile of vascular age and vascular response among elderly patients receiving antihypertensive therapy

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Received: 28 August 2017

Accepted: 01 September 2017

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ABSTRACT

Background: Normally the age of the arteries is same as that of the chronological age of the patient. In Hypertensive patients, complex interactions occur between prohypertensive factors, accelerating vascular age. Furthermore, prohypertensive factors to some extent are responsible for non-response to therapy at optimal doses. We assessed the correlation between response to therapy and vascular age in elderly hypertensives, in addition to vascular age and vascular response.

Methods: In this study, we analysed the clinical records of both male and female hypertensive patients above 60 years old. We collected the details of age, gender, body mass index, systolic blood pressure (treated and untreated), diabetes and smoking. Vascular age was calculated using a composite score of these six prohypertensive risk factors. Accelerated vascular age was then derived using the formula vascular age minus chronological age. The optimal vascular response was considered if the patient's therapeutic blood pressures are less than 140/90mmHg.

Results: In the present study, data from 517 elderly hypertensive patients were analysed, the mean chronological age, vascular age and accelerated vascular age was 66.74±6.6, 79.46±0.42 and 13.46±6.08 years. Only 32.7% were responders to anti-hypertensive treatment. The pattern of usage of anti-hypertensives in our patients is CCBs 39.10% followed by 30.90% ARB, 22.50% ACEI and 8.90% diuretics. The response in 20.50% of patients was achieved with a single drug, in 9.90% with two drugs and only in 2.30% of patients using three drugs. We found that 78.72% of our study population had vascular age more than ten years of chronological age, among them 66.6% between 60-69 years of chronological age were non-responders. We found a significant correlation (P<0.05) between vascular age and non-response to treatment.

Conclusions: The majority (98.6%) of our patients had vascular age more than 80 years due to various risk factors of cardio vascular disease. Non-responsiveness to therapy showed a significant relationship with vascular age.

Keywords: Elderly hypertensives, Non-laboratory based vascular age, Response to antihypertensive therapy

INTRODUCTION

Hypertension is the largest contributor to the global burden of cardiovascular disease. In the elderly, the prevalence of hypertension is more than two times than in the young population. Therefore, hypertension is an ageing disorder. In hypertensive patients, complex interactions occur between prohypertensive factors, leading to accelerated

vascular ageing.¹ Patients who exhibit accelerated vascular ageing have an altered arterial function and structure, and such people often die of cardiovascular disease.^{1,2} The optimal control of blood pressure is considered low with advancing age in both men and women.^{3,4} Many reasons contribute uncontrolled BP includes nonadherence to medications, altered pharmacokinetics and dynamics, white coat hypertension, resistant hypertension, and

patients with suboptimal treatment.⁵⁻⁷ Prohypertensive factors include gender, genetics, obesity, dyslipidemia, sedentary lifestyle, smoking, diabetes and advancing age. Studies have shown that coexistence of risk factors such as diabetes and smoking to some extent decrease the response.⁸ The non-laboratory-based chart estimates vascular age using a composite score of six prohypertensive risk factors, such as age, sex, smoking status, body mass index, systolic blood pressure, and diabetes.⁹ This model, substitute's body-mass index for cholesterol and became a validated proxy to laboratory-based score for assessing the burden cardiovascular disease.^{10,11} However, its role in the management of hypertension has not been studied. We evaluated the profile of vascular age and vascular response among elderly hypertensive patients receiving therapy and explored the relationship between response to therapy and non-laboratory based vascular age in elderly hypertensives.

METHODS

In this retrospective study, we analysed the clinical records of elderly hypertensive outpatients above 60 years old. Data of patients with chronic Kidney Disease, endocrine disorders, congestive heart failure, arrhythmias, cardiomyopathy, coronary and cerebrovascular disease, and active autoimmune disease were not considered for analysis. Details of age, gender, body mass index (BMI), smoking, diabetes (DM), systolic blood pressure (SBP), Diastolic blood pressure (DBP), treatment history and number of antihypertensive medications were recorded in data collection forms. We calculated vascular age using non-laboratory based vascular risk chart (Figure 1) with age, gender, BMI, SBP (treated), DM and smoking.⁹

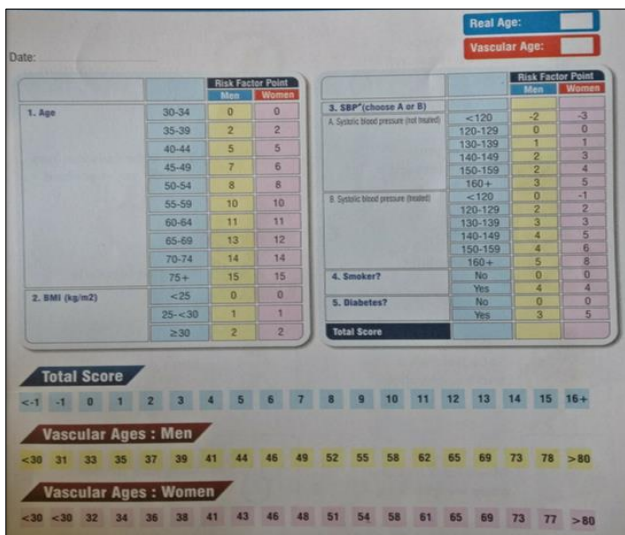


Figure 1: Non laboratory based vascular age calculator.

Accelerated vascular age was then derived using the formula vascular age minus chronological age and

classified into three categories less than five years, 5-10 years and more than a ten years. We considered treatment as monotherapy, if the patients are receiving only one active ingredient and those taking one combination pill or two different pills as polytherapy. Responders were those with therapeutic blood pressures less than 140/90mmHg.^{12,13}

Statistical analysis

Metric data was presented as the mean and standard deviation. Numbers and percentages were used to describe nominal and ordinal data. Statistical analysis was performed using SPSS version-11. To infer the parametric data we applied One way ANOVA and chi-square tests appropriately. We also performed Spearman correlation analysis between response to treatment with accelerated vascular age category and number of antihypertensive medications. A probability values less than 0.05 was considered statistically significant.

RESULTS

In the present study, data from 517 elderly hypertensive patients were analysed, the mean chronological age 66.74±6.6 years, among them, 204/517 (39.8%) were females, and 309/517 (60.2%) were males. 308/517 (59.6%) were diabetics, 205/517 (39.7%) were smokers (Table 2). Mean duration of hypertension was 4.4±1.2 years, and treatment duration was 2.8±1.1 years. The BMI was 24.89±4.2kg/m2. The Mean SBP and DBP are 152.02±17.37 and 94.14±11.12mmHg respectively (Table 1).

Table 1: Descriptive statistics of vascular risk factors.

Variables	Response (<140/90 mmHg)	N	Mean± SD	P value
Age (years)	No	348	66.79±6.48	0.79
	Yes	169	66.63±6.86	
	Total	517	66.74±6.6	
Vascular age (years)	No	348	79.97±.40	0.22
	Yes	169	79.92±.45	
	Total	517	79.46±0.42	
Accelerated vascular Age (years)	No	348	13.34±6.07	0.73
	Yes	169	13.54±6.13	
	Total	517	13.46±6.08	
Body mass index (kg/m2)	No	348	25.05±4.21	0.23
	Yes	169	24.58±4.22	
	Total	517	24.89±4.2	
Systolic blood pressure (mmHg)	No	348	159.22±16.74	<0.0001
	Yes	169	137.20±4.49	
	Total	517	152.02±17.37	
Diastolic blood pressure (mmHg)	No	348	97.47±11.73	<0.0001
	Yes	169	87.28±5.08	
	Total	517	94.14±11.12	

The average vascular age of the patients was 79.46±0.42 years. All our patients had higher vascular age than chronological age. The accelerated vascular age of these patients was 13.46±6.08 years. Despite antihypertensive therapy, only 169/517 (32.7%) of our patients had the optimal therapeutic blood pressure response (<140/90mmHg) and remaining 67.3% of our patients were nonresponders (Table 1).

When we assessed the number of antihypertensive drugs used by these patients, we found that 260/517 (50%) were using a single drug, 188/517 (36%) were using two and remaining 69/517 (13%) were receiving three drugs. The order of usage of anti-hypertensives in our patients is CCBs 39.10% followed by 30.90% ARB, 22.50% ACEI and 8.90% diuretics. Among the responders, 20.50% achieved it with a single drug, 9.90% with two drugs and only 2.30% with three drugs (Table 2).

In our study, we found that 98.6% of our patients had vascular age more than 80 years due to various risk factors of cardio vascular disease. Upon classifying accelerated vascular age into three groups, we noticed that 59/517 (11.4%) were in <5-year group, 51/517 (9.9%) were in a 5-10-year group, and the majority 407/517 (78.7%) were in >10 years group.

Among the patients who had >10 years of accelerated vascular age, 70.8% were between 60-69 years. The majority (48.20%) of non-responders were between 60-69 years, males (38.20%), people with diabetes (42.20%), non-smokers (41.30%), with normal BMI (32.30%) and had accelerated Vascular age >10 years (52.40%). There was a significant correlation between response to therapy and vascular age estimated by using the composite score of prohypertensive factors (P<0.05) (Table 3).

Table 2: Vascular response versus antihypertensive drugs

			Response (<140/90 mmHg)			P value
			No	Yes	Total	
Drugs	One	n	154	106	260	<0.0001
		% of Total	29.80%	20.50%	50.30%	
	Two	n	137	51	188	
		% of Total	26.50%	9.90%	36.40%	
	Three	n	57	12	69	
		% of Total	11.00%	2.30%	13.30%	
Total	n	348	169	517		
	% of Total	67.30%	32.70%	100.00%		
Calcium channel blocker	No	n	206	108	314	0.33
		% of Total	39.90%	20.90%	60.90%	
	Yes	n	141	61	202	
		% of Total	27.30%	11.80%	39.10%	
	Total	n	347	169	516	
		% of Total	67.20%	32.80%	100.00%	
Angiotensin converting enzyme inhibitor	No	n	266	134	400	0.57
		% of Total	51.60%	26.00%	77.50%	
	Yes	n	81	35	116	
		% of Total	15.70%	6.80%	22.50%	
	Total	n	347	169	516	
		% of Total	67.20%	32.80%	100.00%	
Angiotensin receptor blocker	No	n	227	130	357	0.008
		% of Total	43.90%	25.10%	69.10%	
	Yes	n	121	39	160	
		% of Total	23.40%	7.50%	30.90%	
	Total	n	348	169	517	
		% of Total	67.30%	32.70%	100.00%	
Diuretic	No	n	315	156	471	0.62
		% of Total	60.90%	30.20%	91.10%	
	Yes	n	33	13	46	
		% of Total	6.40%	2.50%	8.90%	
	Total	n	348	169	517	
		% of Total	67.30%	32.70%	100.00%	

Table 3: Vascular response versus vascular risk factors.

			Response (<140/90 mmHg)			P value
			No	Yes	Total	
Age (years)	60-69	n	249	117	366	0.64
		% of Total	48.20%	22.60%	70.80%	
	70-79	n	74	42	116	
		% of Total	14.30%	8.10%	22.40%	
	>=80	n	25	10	35	
		% of Total	4.80%	1.90%	6.80%	
Total	n	348	169	517		
% of Total	67.30%	32.70%	100.00%			
Vascular age	<80 Years	n	2	5	7	0.04
		% of Total	0.4%	1.0%	1.4%	
	>=80 Years	n	346	164	510	
		% of Total	66.9%	31.7%	98.6%	
	Total	n	348	169	517	
		% of Total	67.3%	32.7%	100.0%	
Accelerated vascular age	< 5Years	n	39	20	59	0.512
		% of Total	7.50%	3.90%	11.40%	
	5-10 years	n	38	13	51	
		% of Total	7.40%	2.50%	9.90%	
	>10 Years	n	271	136	407	
		% of Total	52.40%	26.30%	78.70%	
Total	n	348	169	517		
% of Total	67.30%	32.70%	100.00%			
Gender	Female	n	149	55	204	0.027
		% of Total	29.00%	10.70%	39.80%	
	Male	n	196	113	309	
		% of Total	38.20%	22.00%	60.20%	
	Total	n	345	168	513	
		% of Total	67.30%	32.70%	100.00%	
BMI (kg/m2)	18.5-24.9	n	167	81	248	0.41
		% of Total	32.30%	15.70%	48.00%	
	25-29.9	n	135	72	207	
		% of Total	26.10%	13.90%	40.00%	
	>=30	n	46	16	62	
		% of Total	8.90%	3.10%	12.00%	
Total	n	348	169	517		
% of Total	67.30%	32.70%	100.00%			
Diabetes	No	n	130	79	209	0.045
		% of Total	25.10%	15.30%	40.40%	
	Yes	n	218	90	308	
		% of Total	42.20%	17.40%	59.60%	
	Total	n	348	169	517	
		% of Total	67.30%	32.70%	100.00%	
Smoking	No	n	213	98	311	0.56
		% of Total	41.30%	19.00%	60.30%	
	Yes	n	135	70	205	
		% of Total	26.20%	13.60%	39.70%	
	Total	n	348	168	516	
		% of Total	67.40%	32.60%	100.00%	

DISCUSSION

In our study, we found that only 32.7% were responders and remaining 67.3% of our patients were nonresponders

to anti-hypertensive treatment. Older persons are known to have the lowest rates of blood pressure control.¹⁴ Factors such as poor adherence to prescription, inadequate doses or inappropriate combinations, polypharmacy, an altered pharmacokinetic and pharmacodynamic states, side effects from medications, and the high cost of drugs and use of non-steroidal anti-inflammatory drugs could have contributed to such a nonresponse.⁵⁻⁷ There can also falsely elevated blood pressure levels due to inappropriate blood pressure recording-technique, noisy room, and non-validated instruments.¹⁵ Only a small percentage (8.90%) of our patients were prescribed of diuretics, and this could be one of the possible reasons for low response rates in our study populations.

Accelerated ageing of arteries is due to coexistence of risk factors such as older age, smoking, BMI as an index by obesity, age, and diabetes. Other potential proinflammatory conditions, such as activation of the sympathetic nervous system, ageing, elevated aldosterone, involvement of oxidative stress and endothelial dysfunction could also contribute to hypertension. Risk factors increase arterial stiffness via alters neurohormonal related pathways and promotes non-responsiveness to therapy.¹⁶⁻¹⁸ We explored whether early vascular ageing as assessed by nonlaboratory based vascular age calculator can predict non-response to anti-hypertensive treatment, and found a significant correlation between vascular age and nonresponse to hypertension treatment. Contrarily, Brown MJ et al, stated that presence of risk factors by themselves does not blunt the target response to therapy in hypertensive patients.⁸

Limitations

Sex-specific NLB vascular age algorithm is originally developed to assess general CVD risk and risk of individual CVD events. Its utility in response to hypertensive treatment remains to be validated. So Carefulness has to be implemented while interpreting our study results. Data regarding the non-adherence to treatment was not available. The highest vascular age according to nonlaboratory based vascular risk chart is more than 80; we rounded it to 80 years for calculation of approximated accelerated vascular age.

CONCLUSION

The majority (98.6%) of our patients had vascular age more than 80 years due to various risk factors of cardiovascular disease. Only 32.7% were responders to antihypertensive therapy. Non-responsiveness to therapy showed a significant relationship with vascular age. Further studies are needed to assess the utility of this non-laboratory based vascular age calculator in predicting the response to antihypertensive response at optimal doses.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Pathapati RM, Chirra BR, Madhavi P, Tandayam A, Kudagi BL, Buchineni M. Profile of vascular age and vascular response among elderly patients receiving antihypertensive therapy. *Int J Basic Clin Pharmacol* 2017;6:2328-33.