A study on relationship between hypertension and cognitive performance

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Abstract

Introduction: Hypertension is a major public health problem in India with a prevalence ranging between 20-40%. Chronically sustained high blood pressure is associated with a number of adverse health effects such as myocardial infarction, renal failure, stroke and may also lead to cognitive decline. The relationship between blood pressure and cognition has varied across studies; hence this study was taken up to evaluate the relationship between hypertension and cognitive performance.

Hypothesis: Hypertension is associated with cognitive decline.

Materials and Method: Study involved 30 hypertensive and 30 normotensive subjects. Hypertension was diagnosed based on JNC VII criteria. Both groups were matched for age and education. Potential alternative psychosocial causes of cognitive impairment such as depression, anxiety, stress were ruled out using DASS21. In both groups, cognitive functions in domains of psychomotor speed, sustained attention, executive functions, short and long term verbal memory were assessed using a battery of performance tests. Results were compiled and statically analyzed using Pearson's Chi- square test, student-t test, odds ratio on SPSS software version 17.

Results: A significant association was found between hypertension and psychomotor speed ($p = <0.01$), sustained attention ($p = <0.01$), short term and long term verbal memory ($p = <0.05$). No association was observed between hypertension and executive functions.

Conclusion: Hypertensives performed poor in set of tasks that measure psychomotor speed, sustained attention, short and long term verbal memory probably because hypertension brings certain pathophysiological changes in brain such as vascular remodelling, impaired cerebral auto regulation, small lacunar infarcts, white matter lesion and amyloid angiopathy. Thus it is imperative to strictly control blood pressure in hypertensives to avoid deleterious effect of hypertension on cognition.

Keywords: Hypertension, Cognition, Attention, Memory, Microvascular brain damage

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Introduction

Hypertension is the most common cardiovascular disease, emerging as a major public health problem in developed as well as developing countries such as India with a prevalence ranging between 20-40%.[1,2] Chronically sustained high blood pressure is associated with a number of adverse health effects such as myocardial infarction, renal failure and stroke.[3]

Hypertension is well-recognized for the development of macroscopic cerebrovascular lesions. It also leads to subtle cerebral microvascular changes such as arteriolar narrowing, which can in due time lead to cognitive impairment.[4,5,6] Loss of cognitive function is a significant factor contributing to loss of personal independency.[7]

The potential damage on cognitive function by hypertension is less clear and has not been examined to the same extent as hypertension effects on cardiovascular disease. Given the significant prevalence of hypertension, it is vital that its consequences including effects on cognition be better understood; hence this study was taken up to evaluate the relationship between hypertension and cognitive performance.

Materials and Method

It was a cross sectional comparative study conducted at a Government Medical College and Research Institute in Bangalore. The study subjects were selected by screening patients from the medicine outpatient department. A total of 60 subjects (30 hypertensives and 30 normotensives) aged between 30 to 59 years of both genders and willing to participate in the study were included for the study. Individuals with depression, anxiety, stress, visual or hearing impairment, history of diabetes mellitus, stroke, myocardial infarction, thyroid dysfunction, any major surgery and those on any drugs that impair cognition like sedatives, anti-histaminics, antipsychotics and antidepressants were excluded from the study. Written informed consent was obtained from all subjects prior to their participation. Ethical clearance was taken from the institutional ethics committee.

Hypertensive and normotensive subjects were recruited by recording their blood pressure using a mercury sphygmomanometer. Hypertension was defined according to seventh report Joint National Committee (JNC) for detection, evaluation and treatment of high blood pressure, as systolic blood pressure more than or equal to 140 mm of Hg or diastolic blood pressure more than or equal to 90 mm of

Hg or those individuals currently taking antihypertensive treatment.[8] Respondents were asked to refrain from smoking or drinking coffee or alcohol for at least an hour before recording blood pressure. Blood pressure was measured by pulse obliteration and auscultation method in sitting position using mercury sphygmomanometer. Two blood pressure readings with at least 30 minutes interval in between were taken and the mean of two readings was used for analysis.

Subjects were interviewed and information regarding educational and literacy status was collected. To rule out depression, anxiety and stress, a self-administered Depression, Anxiety and Stress Scale questionnaire DASS 21 was used with 21 items.[9] In each item, the respondents are to rate the extent to which they have experienced the given state over the past week, using a 4-point severity/frequency scale. Scores for depression, anxiety and stress are calculated by summing the scores for the relevant items. As recommended, the obtained scale scores were multiplied by 2, to make them comparable to the DASS normative data scores. Questions numbered 3, 5, 10, 13, 16, 17, 21 assessed depression, questions numbered 2, 4, 7, 9, 15, 19, 20 assessed anxiety and questions numbered 1, 6, 8, 11, 12, 14, 18 assessed stress.

Cognition domains assessed were psychomotor speed using digit symbol substitution test, sustained attention using digit vigilance test, executive functions which grades the semantic memory by Category fluency test and verbal memory (short and long term) by a passage test.[10-12]

Data entry and analysis was done on SPSS software version 17. Results of continuous measurements are presented in mean ± SD and results of categorical measurements are presented in number (%). Statistical test applied are student t test (two tailed, independent) and Pearson's Chi- square test and p value of less than 0.05 was considered as significant.

Results

The present work is a comparative study enrolling 30 hypertensives and 30 normotensives. The mean age (±SD) of subjects was 47.03 (±5.92) years and 44.37 (±6.15) years for hypertensives and normotensives respectively. The two groups were found to be matched for age and education. The mean systolic blood pressure and mean diastolic blood pressure were statistically different between the study and comparison group [Table 1].

Results of the cognitive assessment in hypertensive and normotensive groups are shown in the Table 2. Four cognitive domains were evaluated. A significant association was found between hypertension and psychomotor speed, sustained attention, short term and long term verbal memory. No significant association was found between hypertension and executive functions.

Table 1: Descriptive analysis of general characteristics of study subjects

Variable	Hypertensives (n=30) Mean (±S.D)	Normotensives (n=30) Mean (±S.D)	p value
Age (yrs)	47.03 (±5.92)	44.37 (±6.15)	NS*
Education (yrs)	14.43 (±1.35)	14.47 (±1.38)	NS*
SBP (mmHg)	136.87 (±6.69)	124.93 (±7.29)	<0.001#
DBP (mmHg)	85.27 (±6.44)	77.07 (±5.65)	<0.001#

*NS - Not significant, #p value is significant

Table 2: Analysis of cognitive domains in hypertensives and normotensives

Variable	Hypertensives		Normotensives		OR (95% CI)	p value
	No.	%	No.	%		
Psychomotor Speed						
Abnormal response	12	40.0	3	10.0	6.03 (1.48-24.29)	<0.01#
Normal response	18	60.0	27	90.0		
Sustained Attention						
Abnormal response	14	46.7	4	13.3	5.68 (1.59-20.33)	<0.01#
Normal response	16	53.3	26	86.7		
Executive Functions						
Abnormal response	17	56.7	12	40.0	1.96 (0.71-5.47)	NS*
Normal response	13	43.3	18	60.0		
Verbal Memory						
Short term verbal memory						
Abnormal response	11	36.7	4	13.3	3.76 (1.03-13.64)	<0.05#
Normal response	19	63.3	26	86.7		
Long term verbal memory						
Abnormal response	13	43.3	5	16.7	3.82	<0.05#

Normal response	17	56.7	25	83.3	(1.15-12.71)	

*NS - Not significant, #p value is significant

Discussion

This study was undertaken to study the relationship between hypertension and cognitive performance. Two groups of 30 hypertensives and 30 normotensives were selected. Both the groups were found to be well matched for factors known to influence cognition like age and educational level. The subjects were also screened for the presence of potential alternative psychosocial confounding contributors which can lead to decrement in cognitive functioning such as depression, anxiety, stress were ruled out in the screening stage. The observed differences in cognitive performance of the two groups are likely due to direct effect of hypertension.

Hypertensives showed a lower performance in tasks that measure psychomotor speed and sustained attention compared to normotensive individuals [Table 2]. This finding is similar to reports from study done by Julie A et al. who found an inverse relationship between hypertension and Psychomotor speed & attention.[13] Compared to normotensive individuals, hypertensives performed poorly at tasks that measure verbal memory. Results from this study agree with those from a study conducted by Swan GE et al.[14] Harrington F et al found that elderly hypertensives with no clinical evidence of organic vascular damage have impaired cognition in a broad range of tests of attention and short- and long-term memory suggesting that this impairment could be a direct consequence of hypertension, most likely mediated through effects on cerebral blood flow or metabolism.[15]

There are a number of possible mechanisms through which hypertension might indirectly impair cognitive function. Blood flow to a specific focal active region in brain increases during a cognitive task. Recurrent auto regulation of blood pressure within the brain due to hypertension leads to hypertrophic changes in blood vessels of central nervous system.[16] There is a general reduction of cerebral blood flow in hypertensives compared to normotensive and also these cerebrovascular changes reduce the efficiency of cerebral blood vessels to produce dilatory responses required to enhance blood flow to focal brain regions in response to specific cognitive tasks.[15] The disturbed cerebral perfusion, has a negative impact on brain cell metabolism and leads to cerebral infarction and diffuse white matter lesions.[18,19] Cognitive impairment may be the direct consequence of ischaemic brain lesions, depending on the volume, location, and number of these vascular lesions.[20]

Studies involving the use of MRI have found an association between hypertension and brain atrophy,[21] leukoaraiosis,[22] lacunae and periventricular hyperintensities[23-25] and white matter hyperintensities.[25-30] White matter lesions that consist of areas of demyelination and narrowing of small arteriolar lumen size have been associated both with hypertension and with cognitive dysfunction.[26] These forms of cerebrovascular changes are often silent without overt clinical neurological symptoms or findings.[31] Cognitive impairment usually develops insidiously, eventually reaching a stage where it becomes clinically and functionally apparent. These subclinical changes in brain morphology may underlie the observed associations between hypertension and cognitive decline. These differences may not be sufficient to interfere with routine activities of daily living but this is associated with increased risk of developing dementia.[15]

A recent interventional study done by Jaiswal et al. suggests that antihypertensive therapy given for 3 months led to improvement in the cognitive function tests scores.[32] Currently there is an established need to treat hypertension to prevent organic diseases like stroke and myocardial infarction. If treating hypertension reduces the rate of cognitive decline, it is an added advantage and extends the benefits of antihypertensive drug treatment.

Creating a general awareness that there is a possibility of obviating cognitive impairment through antihypertensive drug treatment would be a major step forward in the interest of public health. Further studies can be done to elucidate the mechanisms through which hypertension is associated with cognitive impairment and intervention studies to determine effectiveness of long term antihypertensive therapy in preventing cognitive dysfunction.

Conclusion

In conclusion, limited yet growing literature indicates that hypertension is a potential risk factor for cognitive decline. Current study provides an important extension to the existing literature. Thus it is imperative to strictly control blood pressure in hypertensives to avoid deleterious effect of hypertension on cognition.

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