Assessment of cognitive impairment in hypertensive individuals attending a tertiary health-care center in metropolitan city: An analytical study

Nikhil Gode[1], Amol Kinge[2], Shri Karan Jain[3], Prashant Patil[4], Harish Wankhede[5], Dipti Nimje[6]

[1]Assistant Professor, Department of Physiology, [2]Assistant Professor, [3]Statistician cum Assistant Professor, Department of Community Medicine, [4]Assistant Professor, Department of Biochemistry, [5,6]Assistant Professor, Department of Anatomy, Government Medical College, Nandurbar, Maharashtra, India

ABSTRACT

Background: Cognitive impairment is a physiological consequence of ageing. Mostly, after 65 years of age, impairment in the memory and dexterity is common. The various factors for such decline are yet under evaluation. The "Montreal Cognitive Assessment Scale" scoring system is been used in this study. This scale is based on seven domains of cognition. It is developed to improve the chances of early detection of cognitive impairment and it claims to diagnose dementia more efficiently compared to the standard MMSE scale. **Aims and Objectives:** The present study was conducted to compare the cognition status in hypertensive and normotensive individuals of similar age groups. **Materials and Methods:** The study participants were the selected patients attending the hypertension (HTN) OPD in Seth GS Medical college and KEM HOSPITAL Parel, Mumbai and among the staff working. Patients with age 30–40 years and blood pressure (BP) <140/90 mm Hg supine position without taking any anti-hypertensive medication. After selection of study subjects, the cognition status was assessed in both groups using the MoCA instrument. The BP was measured in supine posture, after interval of 10 min between each measurement, with the help of Sphygmomanometer. Unpaired "t"-test was applied to test the significance of difference of mean values of MoCA scale. **Results:** We observed that among hypertensive subjects, comparatively lower MoCA score (mean value: 25.97) was reported. Thirteen (28.88%) study subjects had low MoCA score, whereas 32 (71.11%) hypertensive study subjects had normal MoCA score. **Conclusion:** Thus, if the HTN is of a longer duration, it may show the poor cognitive performance. However, more such studies are required to know the exact mechanism and to know the critical level of BP which can cause cognitive impairment in long standing cases.

Key words: Cognitive impairment; Hypertension; MoCA scale; Dementia

INTRODUCTION

Cognitive impairment is a physiological consequence of ageing. Mostly, after 65 years of age, impairment in the memory and dexterity is common. The various factors for such decline are yet under evaluation.

Increased blood pressure (BP) is the leading risk factor for premature death, stroke, and heart disease worldwide.[1]

In 2000, the world was estimated to have nearly 1 billion people with hypertension (HTN) with an increase to 1.56 billion by 2025.[2] HTN is one of the most prevalent vascular disease in older people and is also responsible for multiorgan damage. Specific cognitive functions affected by consistently high BP are not yet fully determined.[1,2]

The prevalence of dementia increases exponentially with increasing age,[3] doubling with every 5-year increase after

Address for Correspondence:
Dr. Prashant Patil, Assistant Professor, Department of Biochemistry, Government Medical College, Sakri Road, Nandurbar - 425 412, Maharashtra, India. **Mobile:** +91-8208358585. **E-mail:** researchexpert3@gmail.com

age 65. In higher-income countries, prevalence is 5–10% in those aged 65+years and is usually greater among women than men, primarily because women live longer. Within the United States, a higher prevalence has been reported in African-American and Latino/Hispanic than in white non-Hispanic populations. Global systematic reviews and meta-analyses suggest that the prevalence of dementia is lower in sub-Saharan Africa and higher in Latin America than in the rest of the world, also similar reporting from Brazil.[3-5]

MCI is an intermediate state between normal cognition and dementia. Although specific changes in cognition are observed in normal aging, there is an increasing evidence that some forms of cognitive impairment are recognizable as an early manifestation of dementia.[6] Several criteria for, and subtypes of, MCI have been proposed.[7] In general, these criteria include a measurable deficit in cognition in at least one domain, in the absence of dementia or impairment in activities of daily living.

Both HTN and dementia are common in elderly individuals.[8] Among people aged ≥65 years, the prevalence of dementia is ≈8%, and the prevalence of HTN is ≈65%.[2,9] The relation of BP with cognitive function and dementia has recently received much attention in epidemiological studies.[10] The findings of cross-sectional studies of BP and cognitive function have varied greatly in their results. Some studies found higher rates of cognitive impairment associated with elevated BP,[11] others with low BP,[12] and others documented a U-shaped relationship.[13]

The "Montreal Cognitive assessment (MoCA) Scale" scoring system is developed to improve the chances of early detection of cognitive impairment, and to diagnose dementia more efficiently.[14-16]

The present study was conducted at a tertiary healthcare institute in a metropolitan city to assess and compare the cognition status using MoCA Scale in hypertensive and normotensive individuals of similar age groups.

Aims and objectives

1. The aim of the study was to compare the cognition status in hypertensive and normotensive individuals of similar age groups.

The objectives of the study are as follows:
1. To establish a correlation (if any) between HTN and cognition impairment.
2. To assess the BP levels at which cognitive impairments are most frequent.

MATERIALS AND METHODS

Selection of individuals

The study was done in two groups. Before testing, pre-required information and instructions were given to all the subjects and the test was properly explained and demonstrated. The study participants were the selected patients attending the HTN OPD in Seth GS Medical college and KEM HOSPITAL Parel, Mumbai and among the staff working there. Information was given to the staff by the advertisement. All the interested members from the age group of 30–40 years were screened for the BP using sphygmomanometer and were grouped as normotensives or hypertensives.

Ethical consideration

The study was conducted after approval from the Institutional Ethical Committee. Informed consent was taken from both the groups before the procedure. The letter number of the Institutional Ethical Committee approval for the project EC/159/2012, and the letter number was CARE/OUT/935/12, dated October 8, 2012.

According to the census method for sample size calculation, all the individual subjects in the age group of 30–40 years and fulfilling our inclusion criteria were included in the study. For each individual subject, the BP was measured in supine position 3 times with the interval of 10 min between each measurement, ensuring that the individual is completely relaxed. The individuals were declared normotensive if the three successive BP measurements are within normal range that is less than or up to 120/80 mm Hg±10 mm of Hg (JNC 8 HTN guidelines), without any anti-hypertensive medication. BP more than 140/90 mm Hg, supine posture or BP more than 140/90 mm Hg, that is, hypertensive subjects on medication in whom goal is not achieved (JNC 8 HTN guidelines) were included in the hypertensive group. In this study, we are studying newly diagnosed cases because if the cognition impairment is detected in the early stages of HTN than we can take early necessary measures to curb the HTN-related cognition problems in their future.

For ease of our comparison between the two groups, the individuals with similar educational backgrounds, that is, minimally 12th pass and maximally graduates with English subject were included in the study.

Study group 1 (normotensives)
Inclusion criteria

The following criteria of study Group 1 were included in the study:
1. Age 30–40 years
2. BP <140/90 mm Hg supine position without taking any anti hypertensive medication.

3. No H/O dementia, psychiatric disorders, and family history of psychiatric disorders.

Exclusion criteria

The following criteria of study Group 1 were excluded from the study:
1. H/O Cerebrovascular hemorrhage, Type 2 Diabetes Mellitus, Alzheimers Disease, Thyroid disorders.
2. H/O Alcohol addiction and chronic smokers
3. H/O Hearing impairment
4. Severe end organ damage and musculoskeletal disorders

Study group 2 (hypertensives)

Inclusion criteria

The following criteria of study Group 2 were included in the study:
1. Age 30–40 years
2. BP >140/90 mm Hg supine position without any anti-hypertensive medication as well as
3. Hypertensive subjects on medication in since past 1 year
4. No H/O dementia, psychiatric disorders, in family

Exclusion criteria

The following criteria of study Group 2 were excluded from the study:
1. H/O stroke, Type 2 Diabetes mellitus, Alzeimers Disease, and thyroid disorders
2. H/O Alcohol addiction, chronic smokers
3. H/O Hearing impairment
4. Severe end organ damage and musculoskeletal disorders

Instruments

1. Sphygmomanometer (Diamond BPMR112 Mercurial BP Apparatus Regular)
2. Stethoscope
3. The MoCA scale: A brief screening tool for cognitive impairment by, Dr Ziad Nassredine, MD.(Copyright protected and freely available for use).

Procedure

The cognition status was assessed in both groups using the MoCA instrument. The instrument is a questionnaire with 11 questions testing the different aspects of memory in an individual including alternating trail making, visuoconstructional skills, naming, memory, attention, sentence making, repetition, verbal fluency, abstraction, and delayed recall. Score is given to each question. A person can maximally score 30 in this test. A total score of 26 out of 30 is considered normal. Add 1 point for an individual who has 12 years or fewer of formal education, for possible maximum 30 points.

The questions were asked in a clear voice, slowly in quiet surroundings and the individual has to give the answer. If he fails to answer or answers the question wrong, the score was not be given. The instrument provides the physician with specific guidelines as to how to mark the answers and which answer can be considered appropriate.

The instrument is subject to copyright and can be used free of cost for academic purpose as mentioned by the author after including the following statement.

The BP was measured in supine posture, after interval of 10 min between each measurement, with the help of sphygmomanometer

Outcome measures

1. BP in millimeter (mm) of mercury (Hg)
2. Score obtained by MoCA

Statistical analysis and sample size calculation

Sample size is calculated using complete enumeration method or census method, that is, we include each and every patients who fulfill our inclusion and exclusion criteria in normotensive and hypertensive groups. Unpaired "t"-test was applied to test the significance of difference of mean values of MoCA scale

RESULTS

In the present study, we assessed the cognitive impairment among the study subjects with the help of the MoCA. We observed that among hypertensive subjects, comparatively lower MoCA score (mean value: 25.97) was reported. Thirteen (28.88%) study subjects had low MoCA score, whereas 32 (71.11%) hypertensive study subjects had normal MoCA score (Figure 1).

Among normotensive subjects, 10 (22.22%) study subjects had low MoCA score, whereas 35 (77.77%) normotensive study subjects had normal MoCA score (Table 1).

However, when we analyzed the MoCA scores using Student's t test, the scores were not found to be statistically significant (Table 2).

DISCUSSION

Vascular cognitive impairment may result from chronic subcortical arteriopathy or acute cerebrovascular events,

Table 1: Comparison of MoCA score among study groups

Groups	N (number of study subjects)	Mean Score	Low Score	Normal Score
Hypertensive	45	25.9	13 subjects	32 subjects
Normotensive	45	26.5	10 subjects	35 subjects

Table 2: Association of MoCa score with Hypertension

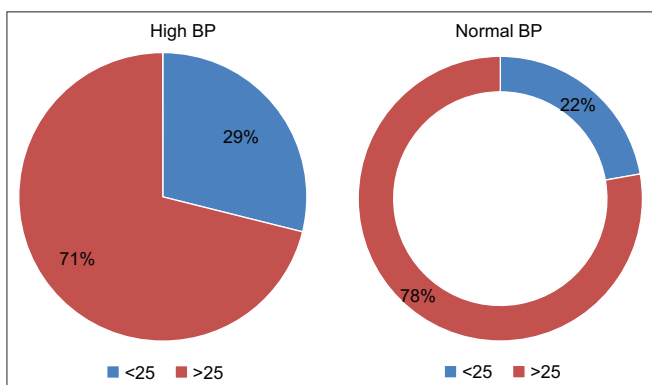| t-Test: Two-sample assuming equal variances	High BP	Normal BP
Mean score (MoCA scale)	25.97	26.55
Variance	2.74	2.34
Observations	45	45
Df		88
t Stat		−1.7174
P (T≤t) one-tail		0.0447
t Critical one-tail		1.662
P (T≤t) two-tail		0.0894
t Critical two-tail		1.987

Figure 1: MoCA Score and age distribution

especially on the background of reduced cerebrovascular reserve. HTN is the strongest risk factor for both acute cerebrovascular events and subcortical arteriopathy and is strongly associated with cognitive impairment. Dong et al., in their study concluded that MoCA is more sensitive than the MMSE in screening for cognitive impairment after acute stroke.[17]

The present study was conducted at a tertiary health-care center to compare the cognition status in hypertensive and normotensive individuals of similar age groups, to establish a correlation (if any) between HTN and cognition impairment, and to assess the BP levels at which cognitive impairments are most frequent.

In the present study, we assessed the cognitive impairment among the study subjects with the help of the MoCA. We observed that among hypertensive subjects, comparatively lower MoCA score (mean value: 25.97) was reported. Thirteen (28.88%) study subjects had low MoCA score,

whereas 32 (71.11%) hypertensive study subjects had normal MoCA score.

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In our study, we have seen that cognitive performance of both the groups hypertensives and normotensives was not affected much. The mean score in both the groups is almost same. Since the subjects in our study are of adult age groups and also the HTN is not of a long standing duration so it has not affected their cognition.

Muela et al.,[18] in their study observed that as compared to the normotension and HTN Stage-1, the severe HTN group had worse cognitive performance based on Mini–Mental State Examination (26.8±2.1 vs. 27.4±2.1 vs. 28.0±2.0; P=0.004) or MoCA (23.4±3.7 vs. 24.9±2.8 vs. 25.5±3.2; P<0.001).

It has been studied in the literature that HTN affects the brain in many ways that could explain its link to cognitive difficulties. Studies have demonstrated that high BP exhibit reduced cerebral blood flow and metabolism and can further affect cognition in old age.[19]

Latest research findings have also shown that hypertensives show smaller blood flow changes than normotensives during performing any memory task. It is important because adequate cerebral blood flow responses are needed for cognitive function.[20]

In the hypertensive patients due to high pressure in their blood vessels, there occurs extravasation of fluid in the surrounding neural tissues which could be due to disturbances in the starlings forces such as hydrostatic pressure and osmotic pressure. The extravasated fluid if present over a prolonged period of time induces pressure over the neural tissues and also affects the cerebral circulation. This consequence can lead to neural functional deficit and can directly affect the cognition.

In the neuronal synapses, the neurotransmitter levels and basic cellular functions are also affected because as there is neural functional deficit due to decreased blood flow, the neurons will not be able to produce the adequate amounts of neurotransmitter while performing the memory tasks.

Limitations of the study

As this was the first local study to assess cognitive impairment, there was no normative data for comparison thus our cognitive impairment estimates could be over- or under-estimated.

Moreover, participants attending this tertiary level hospital may be systematically different to those attending lower level healthcare centers and thus our findings may not be generalizable to all populations in larger geographical region.

CONCLUSION

The present study concludes that the cognitive impairment was more frequent in patients with HTN and this was related to HTN severity. Moreover, also if the HTN is of a longer duration, it may show the poor cognitive performance. However more such studies are required to know the exact mechanism and to know the critical level of BP which can cause cognitive impairment in long standing cases.

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REFERENCES

1. Joffres M, Falaschetti E, Gillespie C, Robitaille C, Loustalot F, Poulter N, et al. Hypertension prevalence, awareness, treatment and control in national surveys from England, the USA and Canada, and correlation with stroke and ischaemic heart disease mortality: A cross-sectional study. BMJ Open. 2013;3(8):e003423.
   https://doi.org/10.1136/bmjopen-2013-003423

2. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK and He J. Global burden of hypertension: Analysis of worldwide data. Lancet. 2005;365(9455):217-223.
   https://doi.org/10.1016/S0140-6736(05)17741-1

3. Hugo J and Ganguli M. Dementia and cognitive impairment: Epidemiology, diagnosis, and treatment. Clin Geriatr Med. 2014;30(3):421-442.
   https://doi.org/10.1016/j.cger.2014.04.001

4. Prince M, Bryce R, Albanese E, Wimo A, Ribeiro W and Ferri CP. The global prevalence of dementia: A systematic review and metaanalysis. Alzheimers Dement. 2013;9:63-75.e2.
   https://doi.org/10.1016/j.jalz.2012.11.007

5. Chaves ML, Camozzato AL, Godinho C, Piazenski I and Kaye J. Incidence of mild cognitive impairment and Alzheimer disease in Southern Brazil. J Geriatr Psychiatry Neurol. 2009;22(3): 181-187.
   https://doi.org/10.1177/0891988709332942

6. Petersen RC, Smith GE, Waring SC, Ivnik RJ, Tangalos EG and Kokmen E. Mild cognitive impairment: Clinical characterization and outcome. Arch Neurol. 1999;56(3):303-308.
   https://doi.org/10.1001/archneur.56.3.303

7. Bischkopf J, Busse A and Angermeyer MC. Mild cognitive impairment--a review of prevalence, incidence and outcome according to current approaches. Acta Psychiatr Scand. 2002;106(6):403-414.
   https://doi.org/10.1034/j.1600-0447.2002.01417.x

8. Tsivgoulis G, Alexandrov AV, Wadley VG, Unverzagt FW, Go RC, Moy CS, et al. Association of higher diastolic blood pressure levels with cognitive impairment. Neurology. 2009;73(8): 589-595.
   https://doi.org/10.1212/WNL.0b013e3181b38969

9. Fratiglioni L, De Ronchi D and Agüero-Torres H. Worldwide prevalence and incidence of dementia. Drugs Aging. 1999;15(5):365-375.
   https://doi.org/10.2165/00002512-199915050-00004

10. Kuo HK, Sorond F, Iloputaife I, Gagnon M, Milberg W and Lipsitz LA. Effect of blood pressure on cognitive functions in elderly persons. J Gerontol A Biol Sci Med Sci. 2004;59(11): 1191-1194.
    https://doi.org/10.1093/gerona/59.11.1191

11. Launer LJ, Masaki K, Petrovitch H, Foley D and Havlik RJ. The association between midlife blood pressure levels and late-life cognitive function. The Honolulu-Asia aging study. JAMA. 1995;274(23):1846-1851.
    https://doi.org/10.1001/jama.1995.03530230032026

12. Guo Z, Fratiglioni L, Winblad B and Viitanen M. Blood pressure and performance on the mini-mental state examination in the very old. Cross-sectional and longitudinal data from the Kungsholmen project. Am J Epidemiol. 1997;145(12): 1106-1113.
    https://doi.org/10.1093/oxfordjournals.aje.a009073

13. Waldstein SR, Giggey PP, Thayer JF and Zonderman AB. Nonlinear relations of blood pressure to cognitive function: The Baltimore Longitudinal Study of Aging. Hypertension. 2005;45(3):374-379.
    https://doi.org/10.1161/01.HYP.0000156744.44218.74

14. Thissen AJ, van Bergen F, de Jonghe JF, Kessels RP, Dautzenberg PL. Applicability and the validity of the Dutch version of Montreal Cognitive Assessment scale (moCA-d) in diagnosing MCI. Tijdschr Gerontol Geriatr. 2010;41(6): 231-240.
    https://doi.org/10.1007/s12439-010-0218-0

15. Lerch M, Decker-Maruska M, Fleck S, Hannusch Y. Could the Montreal cognitive assessment (MoCA) be the new "gold standard" in cognitive evaluation in geriatric patients: A clinical comparision. J Alzheimers Assoc. 2010;6(4S):S494.
    https://doi.org/10.1016/j.jalz.2010.05.1651

16. Fujiwara Y, Suzuki H, Yasunaga M, Sugiyama M, Ijuin M, Inagaki NS, et al. Brief screening tool for mild cognitive impairment in older Japanese: Validation of the Japanese version of the Montreal Cognitive Assessment. Geriatr Gerontol Int. 2010;10(3):225-232.
    https://doi.org/10.1111/j.1447-0594.2010.00585.x

17. Dong Y, Sharma VK, Chan BP, Venketasubramanian N, Teoh HL, Seet RC, et al. The Montreal Cognitive Assessment (MoCA) is superior to the mini-mental state examination (MMSE) for the detection of vascular cognitive impairment after acute stroke.

J Neurol Sci. 2010;299(1-2):15-18.

https://doi.org/10.1016/j.jns.2010.08.051

18. Muela HC, Costa-Hong VA, Yassuda MS, Moraes NC, Memória CM, Machado MF, et al. Hypertension severity is associated with impaired cognitive performance. J Am Heart Assoc. 2017;6(1):e004579.

https://doi.org/10.1161/JAHA.116.004579

19. Forte G, De Pascalis V, Favieri F and Casagrande M. Effects of

blood pressure on cognitive performance: A systematic review. J Clin Med. 2019;9(1):34.

https://doi.org/10.3390/jcm9010034

20. Iadecola C, Yaffe K, Biller J, Bratzke LC, Faraci FM, Gorelick PB, et al. Impact of hypertension on cognitive function: A scientific statement from the American heart association. Hypertension. 2016;68(6):e67-e94.

https://doi.org/10.1161/HYP.0000000000000053

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NG- Accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved; **AK-** Acquisition, analysis, or interpretation of data for the work; **SKJ**- Analysis of data; **PP**- Drafting the work or revising it critically for important intellectual content; **HW**- Analysis of data. Writing of final article for publication; and **DN-** Writing of final article for publication.

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Orcid ID:
Dr. Nikhil Gode - https://orcid.org/0000-0002-1905-7571
Dr. Amol Kinge - https://orcid.org/0000-0002-6051-9811
Shri Karan Jain - https://orcid.org/0000-0001-6338-1822
Dr. Harish Wankhede - https://orcid.org/0000-0003-4151-4289
Dr. Dipti Nimje - https://orcid.org/0000-0003-2511-0276

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