A STUDY OF COGNITIVE IMPAIRMENT IN PATIENTS WITH HYPERTENSION IN THE POPULATION OF WESTERN UTTAR PRADESH AND CORRELATION WITH CLINICAL ASSESSMENT AND NEUROIMAGING

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ABSTRACT :

*Hypertension is one of the most prevalent non-communicable diseases worldwide and is increasingly recognized as an important risk factor for **cognitive impairment**, particularly among aging populations. The present study aims to evaluate the extent of cognitive decline in patients with hypertension in Western Uttar Pradesh and correlate clinical findings with neuroimaging features. A hospital-based observational study was conducted on hypertensive patients attending the Internal Medicine Department of Rama Medical College Hospital & Research Centre, Hapur, from March 2020 to February 2021. Cognitive assessment was performed using standardized tools such as the **Mini-Mental State Examination (MMSE)** and **Montreal Cognitive Assessment (MoCA)**. Detailed clinical examination, blood pressure recording, biochemical investigations and neuroimaging assessment through **Magnetic Resonance Imaging (MRI)** were included to determine structural and functional correlates of cognitive dysfunction. The study focused on identifying the association between duration and severity of hypertension and specific cognitive domains such as memory, attention, executive function and visuospatial ability. Brain MRI findings were analyzed for markers such as **white matter hyperintensities (WMH)**, **cortical atrophy**, **lacunar infarcts**, and **microvascular ischemic changes**. Results indicated that cognitive impairment was significantly more prevalent in patients with long-standing or poorly controlled hypertension. MRI abnormalities were found to correlate with lower MMSE and MoCA scores, suggesting the impact of chronic hypertension on microvascular integrity and neuronal connectivity. The study emphasizes the importance of early diagnosis, regular monitoring and optimal blood pressure control in preventing or delaying the progression of cognitive decline. Given the growing burden of hypertension in India, especially in semi-urban regions like Western Uttar Pradesh, this study highlights the need to integrate cognitive screening into routine clinical evaluation of hypertensive*

patients. The findings further support the role of neuroimaging as a valuable tool in identifying early structural changes associated with cognitive dysfunction.

KEYWORDS:

Hypertension, Cognitive Impairment, MMSE, MoCA, MRI Brain, White Matter Hyperintensities, Western Uttar Pradesh

INTRODUCTION :

Hypertension is a major global health concern and a leading modifiable risk factor for cardiovascular, cerebrovascular and renal diseases. In recent years, growing evidence has suggested a strong association between **hypertension and cognitive impairment**, particularly due to its impact on cerebral microcirculation and neuronal integrity. Cognitive impairment encompasses a broad spectrum ranging from mild cognitive decline to severe dementia, with the potential to affect memory, executive functions, attention and visuospatial abilities. In the Indian scenario, the burden of hypertension is rapidly increasing, especially in Northern and Western states, where lifestyle changes, dietary patterns and stress contribute significantly to disease prevalence. Western Uttar Pradesh, being a region with mixed rural and semi-urban populations, presents a unique demographic for studying hypertension-related cognitive changes. Early cognitive decline may remain unnoticed in hypertensive individuals, leading to progressive deterioration affecting daily functioning and quality of life. The **pathophysiological mechanisms** underlying hypertension-induced cognitive dysfunction include endothelial damage, chronic hypoperfusion, oxidative stress, inflammation and disruption of the blood-brain barrier. These processes result in structural brain changes such as **white matter hyperintensities**, **microinfarcts**, and **cortical atrophy**, which are frequently detected on neuroimaging modalities like MRI. Neuroimaging plays a crucial role in detecting early brain changes even before overt cognitive symptoms appear, providing invaluable information for diagnosis and treatment planning. Clinical assessment tools such as the MMSE and MoCA are widely used for screening cognitive impairment, offering insights into various cognitive domains. While MMSE is more suited for moderate to severe impairment, MoCA is particularly sensitive to mild cognitive decline, making the combined use of these tools ideal for comprehensive assessment. Despite global evidence linking hypertension with cognitive dysfunction, regional data from Western Uttar Pradesh remain limited. Socioeconomic factors, limited awareness and delayed healthcare-seeking behavior often contribute to uncontrolled hypertension, increasing the risk of neurocognitive complications. This study aims to fill this gap by analyzing cognitive performance in hypertensive patients of this region and correlating it with clinical parameters and MRI findings. Understanding the relationship between blood pressure control, duration of hypertension and cognitive decline can help design effective preventive

strategies. Furthermore, identifying early structural abnormalities on MRI can support timely intervention and management. The study's ultimate goal is to emphasize the need for incorporating cognitive screening and neuroimaging evaluation into routine hypertension management protocols to reduce long-term morbidity.

MATERIALS AND METHODS:

This hospital-based observational study was conducted in the Department of Internal Medicine at Rama Medical College Hospital & Research Centre, Hapur, Western Uttar Pradesh, from 05 March 2020 to 17 February 2021. The study aimed to assess **cognitive impairment in hypertensive patients** and correlate clinical assessment findings with neuroimaging results. Ethical approval was obtained from the Institutional Ethics Committee prior to commencement. A total of hypertensive patients aged 35–80 years were included through simple random sampling from outpatient and inpatient departments. Inclusion criteria were: clinically diagnosed hypertension based on **JNC-8 guidelines**, patients on antihypertensive therapy or newly diagnosed cases, and individuals willing to undergo cognitive testing and MRI. Exclusion criteria included history of stroke, neurodegenerative diseases, psychiatric illness, head injury, substance abuse, chronic kidney disease stage 4 and 5, and those unable to complete cognitive tests. All participants provided informed written consent. Detailed demographic data including age, gender, education level, occupation, socioeconomic status and lifestyle habits were collected. Clinical evaluation included measurement of **blood pressure**, pulse rate, BMI, comorbid conditions such as diabetes, dyslipidemia, thyroid disorders and cardiovascular diseases. Blood pressure was measured using a calibrated sphygmomanometer in the sitting position after adequate rest, with the average of three readings considered. Cognitive assessment was performed using two standardized tools: **Mini-Mental State Examination (MMSE)** and **Montreal Cognitive Assessment (MoCA)**. MMSE scores ≤ 23 and MoCA scores < 26 were considered indicative of cognitive impairment. Both tests were administered in the patient's preferred language (Hindi/English) by trained residents. Each domain including orientation, registration, attention, recall, language, abstraction and visuospatial skills was documented. Laboratory investigations included complete blood count, fasting blood sugar, HbA1c, lipid profile, renal function test, serum electrolytes, thyroid profile and vitamin B12 levels to rule out other causes of cognitive decline. Neuroimaging was conducted using **1.5 Tesla MRI**. MRI sequences included T1-weighted, T2-weighted, FLAIR, DWI and SWI. Imaging findings evaluated were: **white matter hyperintensities**, **periventricular changes**, **lacunar infarcts**, **microangiopathic ischemic changes**, **cortical/subcortical atrophy**, **microbleeds**, **ventricular enlargement** and **hippocampal volume reduction**. The severity of WMH was graded using the **Fazekas scale**. Statistical analysis was performed using SPSS software (version 25). Continuous variables were expressed as mean ± SD, while categorical variables were presented as percentages. Independent t-tests, chi-square tests and ANOVA were used to analyze significance. Pearson correlation was

applied to assess relationships between blood pressure parameters, cognitive scores and MRI findings. A p-value < 0.05 was considered statistically significant. The methodology ensured comprehensive evaluation of hypertension-related cognitive impairment while minimizing confounding factors.

RESULTS:

The study included hypertensive patients aged 35–80 years, with a male-to-female ratio demonstrating slight male predominance. Cognitive impairment based on MMSE and MoCA scores was found in a significant proportion of participants. Patients with uncontrolled or long-standing hypertension showed notably lower cognitive scores. The mean MMSE score among hypertensive individuals with >5 years disease duration was markedly lower compared to those with recently diagnosed hypertension. Similarly, MoCA scores showed decreased performance in attention, executive function and visuospatial domains. MRI findings revealed that **white matter hyperintensities** were the most common abnormality, predominantly in periventricular and deep white matter regions. Higher Fazekas grades correlated with poorer MoCA scores. Presence of lacunar infarcts was associated with significant deficits in executive function and processing speed. Cortical atrophy was more prevalent in elderly hypertensive patients and showed strong correlation with global cognitive decline. Patients with combined MRI abnormalities (WMH + lacunes + atrophy) demonstrated the lowest cognitive scores. Statistical analysis confirmed significant correlation between systolic blood pressure, duration of hypertension and severity of MRI findings with cognitive impairment. The results emphasize that chronic uncontrolled hypertension plays a critical role in structural brain changes that contribute to cognitive dysfunction.

DISCUSSION :

This study demonstrates a strong association between hypertension and cognitive impairment in the Western Uttar Pradesh population. The correlation between poor blood pressure control, long disease duration and MRI abnormalities reinforces the role of chronic hypertension in causing microvascular damage. Findings support global evidence that early cognitive decline is linked to white matter changes and small vessel disease. Routine cognitive screening and periodic neuroimaging may help detect early decline and prevent progression.

SUMMARY :

Hypertension significantly contributes to early cognitive decline, particularly affecting memory, attention and executive function. MRI findings such as white matter hyperintensities and lacunar infarcts strongly correlate with reduced MMSE and MoCA scores. The study highlights the need for regular cognitive assessment in hypertensive patients and emphasizes early control of blood

pressure to prevent long-term neurological consequences. Incorporating neuroimaging into evaluation protocols may enable timely detection of structural brain changes.

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